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QUATERNARY GEOLOGY OF THE MARTINSVILLE ALTERNATIVE SITE CLARK COUNTY, ILLINOIS

B. Brandon Curry, Richard C. Berg, and, Madalene R. T. Cartwright

an open file report to Battelle Memorial Institute

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Department of Energy and Natural Resources
ILLINOIS STATE GEOLOGICAL SURVEY

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INTRODUCTION

Isolation of low-level radioactive waste (LLRW) can be achieved effectively with a well-designed, well-engineered containment structure and suitable geologic and other features, such that flow of a potential contaminant in groundwater to an accessible environment (such as aquifers, wells, rivers, etc.) is minimized.

The physical properties, thickness, distribution, genesis, and age of the geologic units provide the framework for understanding modern geologic and geomorphic processes, as well as for subsequent groundwater and geochemical modeling. Understanding these parameters is necessary to examine geologic and hydrogeologic suitability for licensing decisions.

Battelle Memorial Institute is investigating two alternative sites for licensing as a LLRW disposal facility in Illinois. One site is near Geff (Jefferson City) in Wayne County; the other, just north of Martinsville in Clark County and the subject of this report, is called the Martinsville Alternative Site (MAS; fig. 1).

The purpose of this open-file report is to characterize and interpret the genesis of Quaternary geologic units at the MAS and north-central Clark County by providing and summarizing data produced by the Illinois State Geological Survey (ISGS) and consultants to Battelle. The ISGS assisted consultants to Battelle in the description and interpretation of the Quaternary stratigraphic framework by providing a regional stratigraphic model, independent and cooperative descriptions of core and outcrop from or adjacent to the MAS, and clay mineral analyses. Stratigraphic relationships of glacial geologic units described in the Clark County region are correlated with the stratigraphy at the MAS (Curry et al., 1989). Nomenclatural differences between informal names used at the MAS by Battelle Memorial Institute and Hanson Engineers (1990a) and formal lithostratigraphic units used in the region and the state are discussed. This report uses data available as of January 1990; additional data have been obtained and incorporated in Battelle Memorial Institute and Hanson Engineers (1990a). The additional data also necessitated the revision of figures, tables, and some conclusions, which are presented in a subsequent open-file report (Curry, et al., 1991).

A sequence of Quaternary glacial sediments never has been studied so thoroughly in this region of Illinois. A thorough study was required to resolve the complex relationships among the lithostratigraphic units. The stratigraphy and genetic interpretations of the geologic units at the MAS establish a significant glacial stratigraphic framework for future geological, engineering, and environmental studies in east-central Illinois.

BACKGROUND

Data Sources

Five primary data sources are used to characterize the regional and site-specific geology of the Martinsville Alternative Site. The data are from:

1. Forty-five borings that were continuously sampled under quality assurance programs (Hanson Engineers, 1989a,b). These boringsare prefixed with "M-" or "CN-" in figure 2.

2. Five reconnaissance borings (CLK-01-02 and CLK-03-01 in fig. 1 and CLK-02-01, CLK-02-02, and CLK-02-03 in fig. 2) that provided split-spoon samples about 1.5 feet long, collected at 5-foot intervals (Battelle Memorial Institute and Hanson Engineers, 1988). These samples were analyzed in great detail to develop the stratigraphic framework. The data were not collected under a quality assurance program.

3. Nine outcrops, including some previously described by MacClintock (1929) (figs. 1 and 2).

4. Four outcrops and one core from an unpublished Master's thesis (Kettles, 1980; sites shown in fig. 1 in this report).

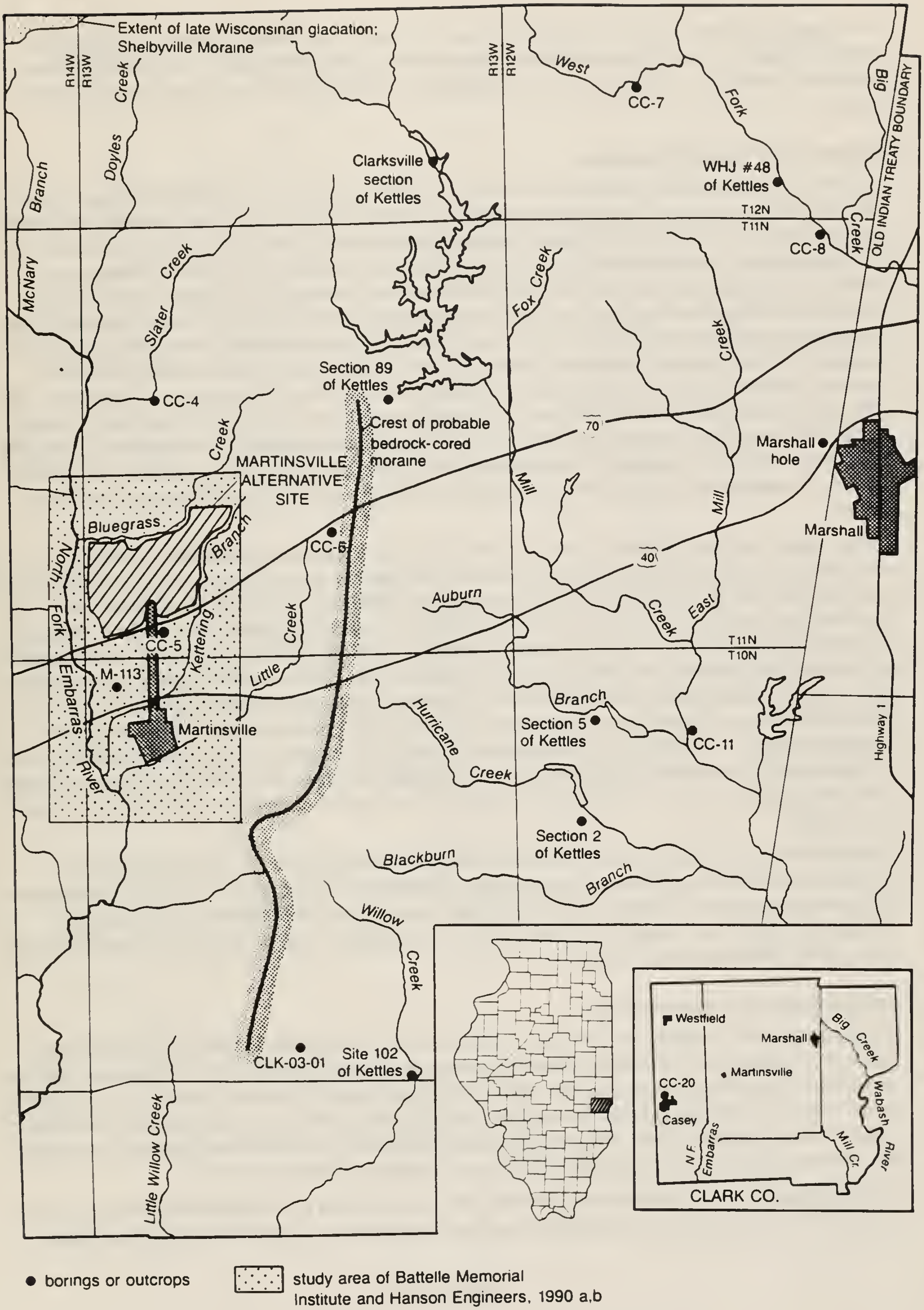


Figure 1 Location of study area, outcrops, and reconnaissance borings.

This database is not the same as that presented in Battelle Memorial Institute and Hanson Engineers(1990a,b); their database includes other borings at the MAS that we did not include because of proximity to existing data. We include data from beyond Battelle's study area shown in figure 1.

Methods and Quality Assurance

With the exception of core collected from the CLK series of borings, technical procedures used in gathering and preparing data met the standards of Battelle Memorial Institute's quality assurance program (Hanson Engineers, 1989a,b). The procedures used in this study include core and outcrop descriptions, semiquantitative mineralogical analysis of the <2 µm fraction, radiocarbon dating, and particle-size analyses by hydrometer and wet sieving (ISGS, 1989). The following data, generated by Hanson Engineers, Inc. and contained in the project technical database (Battelle Memorial Institute and Hanson Engineers, 1990c) in accordance with Battelle's quality assurance program (Hanson Engineers, 1989a,b), also are summarized in this report: moisture content, particle-size determinations by hydrometer and wet sieving, coefficient of uniformity, and Atterberg limits (plastic limit, liquid limit, and plasticity index). All data are summarized in the appendix by borehole or outcrop number and depth. Technical procedures not approved by Battelle but used by the ISGS include 207 particle-size analyses by a Sedigraph. In addition, Dr. William McCoy, University of Massachusetts at Amherst, made 11 amino-acid racemization measurements.

In this report, the percentage of gravel (>2 mm) was calculated from the whole sample. The categories of grain size for particle diameters <2 mm include: sand, 2 mm to 0.063 mm; silt, 0.063 mm to 0.004 mm; and clay, <0.004 mm. Particle-size distribution analyses of samples from borings M-01 to M-131 and M-135 were conducted by Hanson Engineers, Inc., unless otherwise noted in the appendix key. Data from some borings (i.e., M-132, M-133, etc.) were not available at the time this report was written. Grain-size data from this source were extrapolated from grain-size curves. Sample splits were submitted to the Inter-Survey Geotechnical Laboratory for particle-size distribution analyses by hydrometer or Sedigraph. Data obtained from a Sedigraph analysis include a cumulative plot of grain-size of particles less than 53 µm across, determined by an automated X-ray absorption technique; coarser particles were analyzed by wet sieving. Grain-size class, such as loam, silt loam, etc., follows that of the U. S. Department of Agriculture (Buol et al. 1983).

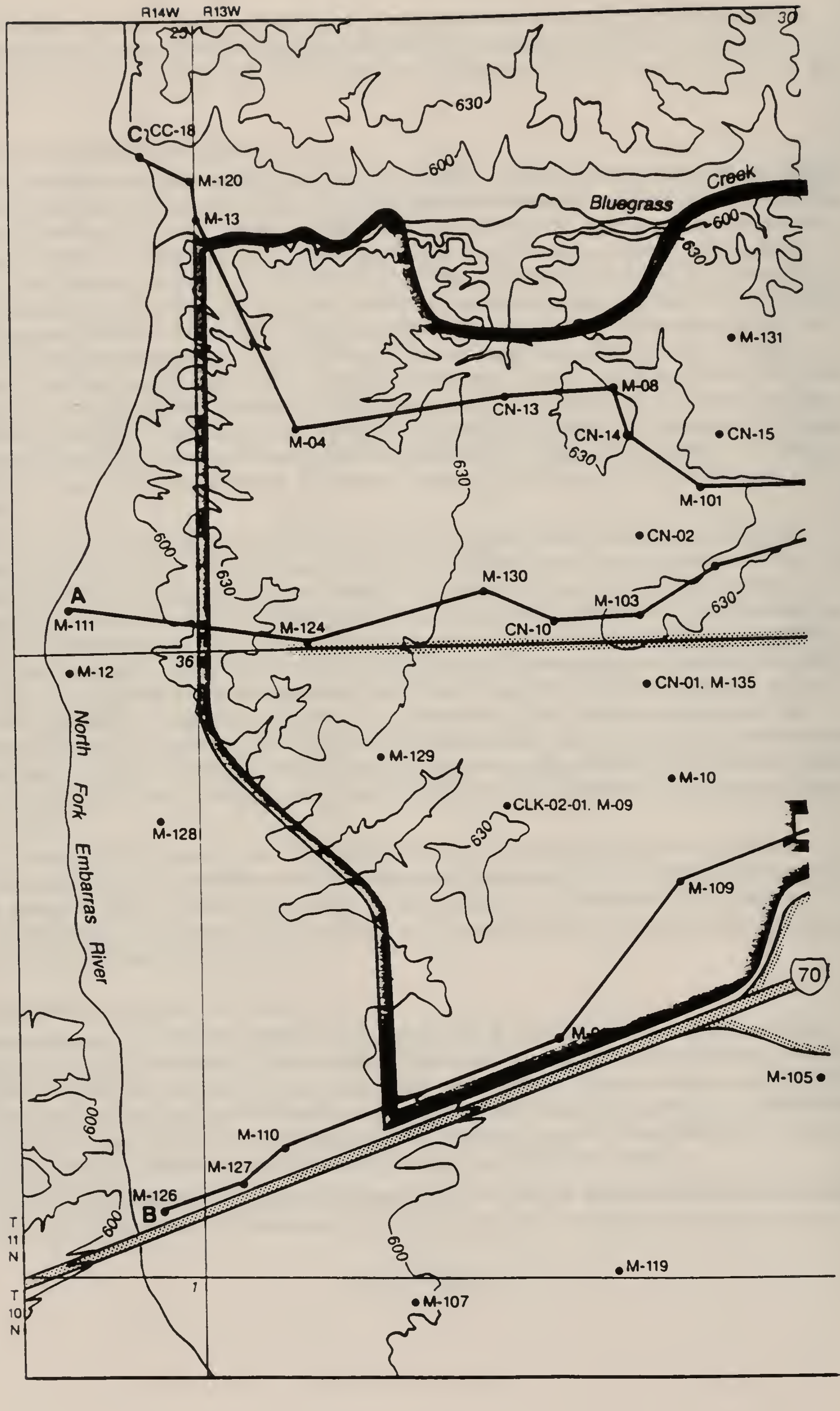
Approximately 1500 sample splits of outcrop and core were analyzed for semi-quantitative mineralogy of the <2 µm fraction using the procedures discussed in ISGS (1989). Other selected clay mineral analyses, reported by Kettles (1980) and listed in the appendix, were from the laboratory work of Dr. Herbert D. Glass, ISGS, who developed this technical procedure (Hallberg et al., 1978; Wickham et al., 1988).

Interpretation of Laboratory Data

Characterization and differentiation of the geologic units is achieved by visual description augmented with data from semiquantitative mineralogical analyses, particle-size distribution, and the coefficient of uniformity (table 1). Less useful were data related to sample moisture, such as moisture content and Atterberg limits. Nondiagnostic data, which include the coefficient of curvature, liquidity index, specific gravity, and porosity, are not included in the data compilation in this report, but are reported in Battelle Memorial Institute and Hanson Engineers (1990c).

The coefficient of uniformity is useful in separating till members in stratigraphically complex areas at the MAS. The coefficient is calculated from cumulative plots of particle size by the equation

$$Cu = D_{60}/D_{10}.$$


R14W
R13W
25
30
630
600
C
CC-18
M-120
M-13
Bluegrass
Creek
M-131
M-08
CN-13
M-04
CN-14
CN-15
M-101
CN-02
M-130
M-103
A
M-111
M-124
CN-10
36
M-12
CN-01, M-135
North Fork Embarras River
M-129
M-10
CLK-02-01, M-09
M-128
M-109
70
M-105
M-110
M-127
M-126
B
T
11
N
T
10
N
M-119
1
M-107

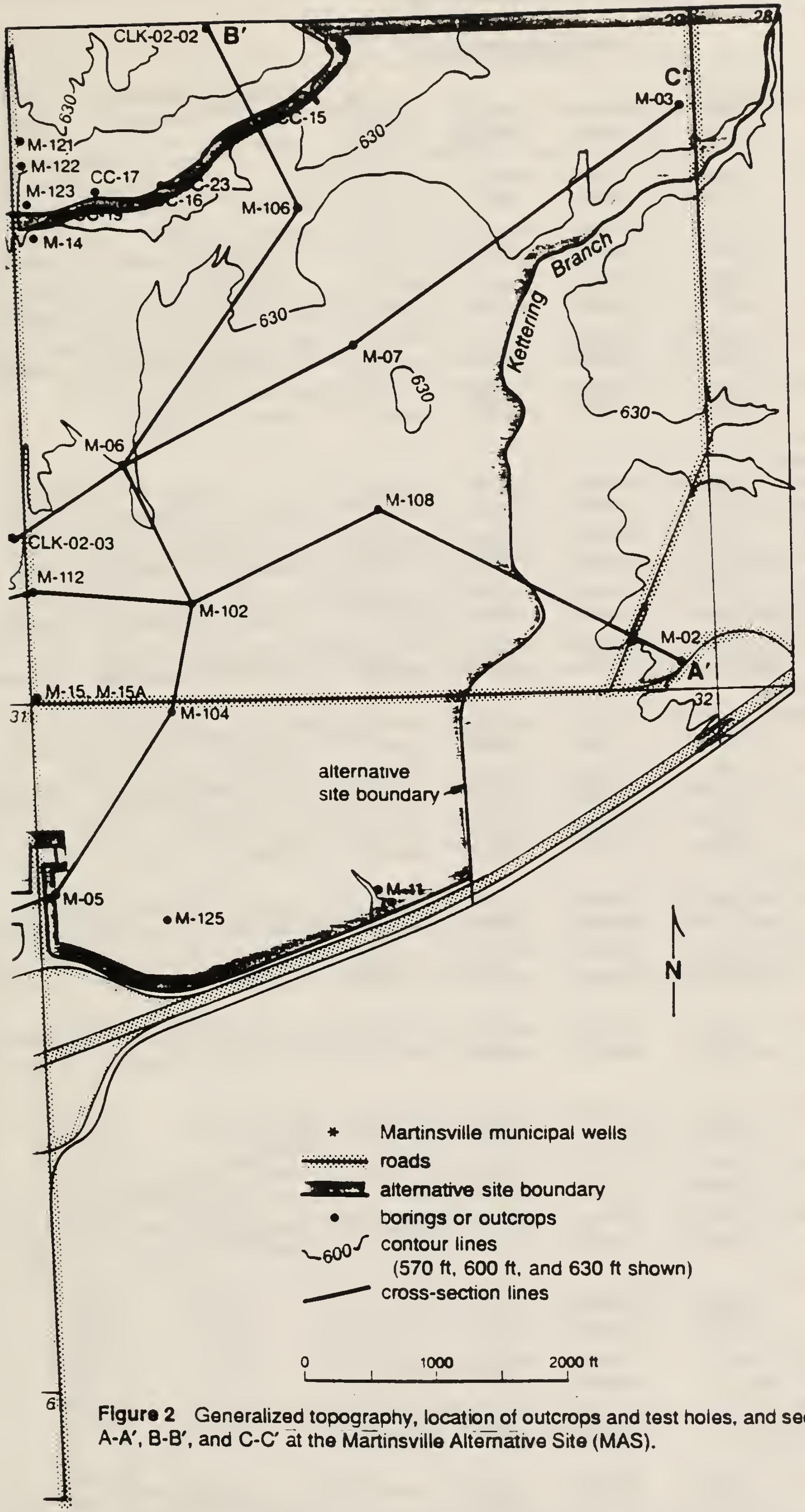


Figure 2 Generalized topography, location of outcrops and test holes, and section lines A-A', B-B', and C-C' at the Martinsville Alternative Site (MAS).

Table 1 Mean, standard deviation and range of particle-size distribution, moisture content, coefficient of uniformity, Atterberg limits, and semiquantitative mineralogy of the $<2\mu m$ fraction of subsamples of core and outcrop.

Unit	Particle size distribution (mm): Total gravel (%) >2	< 2: Sand (%) 2.0-0.63	< 2: Silt (%) 0.63-0.004	< 2: Clay (%) <0.004	Moisture content W%	Coeffient of uniformity Cu	Atterberg Limits: Liquid limit	Atterberg Limits: Plastic limit	Atterberg Limits: Plasticity index
Cahokia Alluvium (c)	5.6 ± 15.7* 0-84(46)	47.8 ± 35.9 2-97(46)	34.0 ± 25.1 1-82(46)	18.2 ± 14.4 2-59(46)	21.2 ± 7.1 8.5-51.5(31)	27.7 ± 38.2 1.8-207.5(33)	29.6 ± 7.8 16-47(15)	16.3 ± 3.6 11-26(15)	13.3 ± 5.7 0-23(15)
Peoria Loess (p)	0.5 ± 0.7 0-3(37)	10.3 ± 4.1 4-21(37)	55.3 ± 6.1 44-69(37)	34.4 ± 7.6 20-49(37)	24.9 ± 3.8 14.0-32.0(34)	13.9 ± 2.7 8.6-18.5(32)	41.5 ± 9.7 28-60(18)	17.8 ± 2.3 14-22(18)	23.6 ± 11.1 7-44(18)
Roxana Silt (r)	1.2 ± 1.4 0-6(31)	25.3 ± 6.5 6-38(31)	40.9 ± 4.8 27-48(31)	33.9 ± 5.5 20-46(31)	20.5 ± 3.7 8.8-28.7(27)	20.5 ± 9.8 10.4-54.8(19)	38.9 ± 8.1 25-54(20)	13.7 ± 1.7 11-18(20)	25.2 ± 8.1 8-37(20)
Berry Formation (b)	3.4 ± 2.5 0-12(70)	37.0 ± 9.7 14-64(71)	30.3 ± 7.2 15-47(71)	32.7 ± 6.4 13-47(71)	20.2 ± 3.5 14.0-40.9(66)	45.6 ± 64.2 12.0-185.0(40)	35.5 ± 6.4 21-48(42)	12.3 ± 1.8 8-17(42)	23.2 ± 6.1 6-35(42)
Pearl Formation (pe)	3.0 ± 4.1 0-15(12)	74.6 ± 22.0 14-95(12)	11.7 ± 10.8 3-37(12)	13.7 ± 13.6 0-54(12)	18.4 ± 6.9 4.8-27.0(8)	69.2 ± 83.7 2.6-255.0(8)	—	—	—
Glasford Formation									
Vandalia Till Member									
melange facies, weathered (gv-mx)	6.0 ± 3.6 3-11(3)	44.6 ± 4.4 39-52(6)	28.8 ± 6.2 22-38(6)	26.7 ± 3.8 22-31(6)	11.9 ± 1.7 9.7-13.9(3)	134.1 ± 6.4 125.2-139.6(3)	23.0 ± 1.4 22-25(3)	11.7 ± 0.5 11-12(3)	11.3 ± 1.9 10-14(3)
melange facies, oxidized (gv-mo)	5.4 ± 4.1 1-28(41)	45.7 ± 5.0 32-63(66)	30.7 ± 3.5 22-39(66)	23.7 ± 4.1 11-31(66)	12.1 ± 4.6 6.8-25.0(40)	111.4 ± 52.3 25.4-312.3(24)	21.7 ± 3.0 15-28(22)	11.9 ± 1.2 10-15(22)	9.9 ± 2.8 3-15(22)
melange facies, unoxidized (gv-m)	7.7 ± 4.8 1-33(86)	45.4 ± 7.4 14-65(86)	33.0 ± 7.6 19-68(86)	21.6 ± 5.1 8-33(86)	8.6 ± 1.9 4.1-19.4(88)	112.3 ± 47.4 13.7-298.6(76)	20.2 ± 2.9 14-35(73)	10.9 ± 0.8 8-14(73)	9.3 ± 2.9 3-23(73)
uniform diamicton facies (gv-u)	8.0 ± 4.5 0-41(473)	42.4 ± 4.6 14-57(488)	35.2 ± 4.8 22-76(488)	22.4 ± 3.3 8-33(488)	9.9 ± 1.7 4.7-21.3(457)	102.2 ± 55.7 10.1-904.0(448)	21.9 ± 2.0 17-31(363)	11.8 ± 0.9 8-16(363)	10.1 ± 1.9 1-17(363)
Mulberry Grove Member									
sand & gravel facies (gm-z)	20.7 ± 19.1 0-69(48)	82.3 ± 13.6 48-97(48)	12.9 ± 10.5 1-41(48)	4.8 ± 3.5 1-17(48)	14.8 ± 5.6 6.0-36.4(42)	28.9 ± 39.2 2.1-176.5(41)	17.3 ± 1.7 15-20(6)	13.0 ± 0.8 12-14(6)	4.3 ± 2.4 1-8(6)
diamicton facies (gm-d)	10.5 ± 7.2 3-30(20)	44.2 ± 13.2 31-96(20)	37.1 ± 9.5 3-47(20)	18.8 ± 5.5 1-24(20)	10.4 ± 2.9 5.2-19.5(19)	84.8 ± 53.1 10.7-229.4(17)	20.9 ± 1.8 19-25(15)	11.9 ± 0.8 11-13(15)	8.9 ± 1.6 6-12(15)
silt facies (gm-s)	2.1 ± 2.0 0-8(12)	17.3 ± 9.3 5-38(12)	63.4 ± 13.1 38-78(12)	19.3 ± 7.1 10-34(12)	17.3 ± 5.4 11.0-32.8(12)	17.7 ± 6.1 4.5-25.1(12)	28.0 ± 7.8 21-46(9)	18.4 ± 5.7 12-32(9)	9.6 ± 6.9 0-20(9)
Smithboro Till Member									
loam diamicton facies (gs)	5.9 ± 3.8 0-24(105)	31.6 ± 6.8 26-70(109)	45.1 ± 6.8 17-56(109)	23.3 ± 5.1 8-37(109)	12.9 ± 2.3 9.0-23.2(104)	46.1 ± 29.6 11.4-209.7(83)	25.8 ± 3.4 18-40(82)	13.6 ± 1.5 11-22(82)	12.2 ± 3.6 1-28(82)
silt diamicton facies (gs-s)	3.5 ± 3.0 0-17(215)	18.4 ± 4.6 2-25(218)	57.2 ± 7.8 26-83(218)	24.5 ± 5.5 10-52(218)	17.3 ± 2.9 11.0-31.8(208)	24.9 ± 5.9 7.0-45.6(194)	28.4 ± 3.7 21-61(194)	15.7 ± 2.2 11-27(194)	12.7 ± 4.3 0-44(194)
Petersburg Silt (ps)	1.3 ± 3.4 0-16(61)	11.2 ± 16.3 0-94(61)	66.7 ± 15.0 3-90(61)	22.1 ± 9.9 3-47(61)	22.1 ± 4.4 9.4-32.7(56)	16.5 ± 6.9 4.5-39.2(54)	28.9 ± 4.6 21-45(47)	19.0 ± 2.9 14-25(47)	10.0 ± 5.2 0-23(47)
Martinsville sand									
silt facies (ms-s)	0.6 ± 0.6 0-2(13)	26.0 ± 16.5 2-52(13)	42.5 ± 19.8 14-77(13)	31.2 ± 15.5 13-76(13)	19.2 ± 2.6 16-23(12)	—	—	—	—
sand and gravel facies (ms-z)	17.9 ± 22.1 0-90(40)	79.1 ± 11.6 51-95(40)	13.6 ± 8.2 0-36(40)	7.7 ± 7.0 0-38(40)	17.8 ± 7.6 7.1-42.5(38)	41.9 ± 46.8 2.5-156.8(34)	—	—	—
diamicton facies (ms-d)	9.6 ± 10.9 0-31(14)	38.2 ± 11.7 14-59(14)	38.4 ± 9.8 23-55(14)	22.2 ± 8.4 5-38(14)	17.3 ± 2.8 13.4-23.1(11)	69.6 ± 24.8 30.7-149.8(8)	24.8 ± 2.0 22-28(6)	13.7 ± 1.5 12-16(6)	11.2 ± 1.3 9-13(6)
Banner Formation									
Lierle Clay Member (bl)	4.0 ± 9.5 0-35(12)	28.7 ± 11.8 7-54(12)	40.2 ± 13.6 26-70(12)	31.1 ± 8.0 17-48(12)	—	—	—	—	—
Casey Till Member, oxidized (bc-o)	—	30.5 ± 5.1 23-44(16)	39.8 ± 5.3 31-52(16)	29.9 ± 4.2 21-37(16)	—	—	—	—	—
Casey Till Member, unoxidized (bc)	—	38.0 ± 6.9 25-46(12)	38.2 ± 4.4 32-48(12)	24.8 ± 4.8 19-36(12)	—	—	—	—	—
Bond Formation (Pb)	3.9 ± 7.7 0-37(30)	30.5 ± 21.9 0-81(30)	43.4 ± 15.6 13-75(30)	28.1 ± 15.9 5-70(30)	15.7 ± 6.3 8.1-43.5(34)	34.3 ± 25.8 2.3-97.5(24)	32.2 ± 12.1 21-81(17)	19.2 ± 3.0 13-26(17)	13.0 ± 11.3 2-38(17)

*mean ± standard deviation
range (number of samples)

Mineralogy of the $<2\mu$m fraction							
Expandable clay minerals %	Illite %	Chlorite & kaolinite %	Calcite (CPS)	Dolomite (CPS)	Vermiculite index	Diffraction intensity ratio	Heterogencous swelling index
47.0 ± 18.6 10-79(34)	36.3 ± 13.3 14-59(34)	17.3 ± 6.4 7-31(34)	5.1 ± 13.5 0-60(34)	4.4 ± 11.2 0-40(34)	27.3 ± 11.0 5-46(34)	1.5 ± 0.3 0.9-2.0(34)	9.4 ± 6.5 0.24(34)
53.2 ± 14.4 27-82(29)	27.8 ± 9.1 11-44(29)	19.0 ± 7.0 7-36(29)	-0- 0-0(29)	-0- 0-0(29)	38.4 ± 8.0 20-55(28)	1.0 ± 0.4 0.7-2.0(29)	7.1 ± 4.5 1-19(28)
67.9 ± 11.8 37-87(24)	18.4 ± 8.3 6-44(24)	13.8 ± 4.3 7-23(24)	-0- 0-0(24)	-0- 0-0(24)	47.4 ± 7.0 1-59(47)	0.5 ± 0.5 0.6-1.6(47)	7.9 ± 4.6 3-26(23)
62.0 ± 16.2 21-89(62)	24.7 ± 13.5 6-66(62)	13.2 ± 4.8 4-23(62)	-0- 0-0(62)	-0- 0-0(62)	42.9 ± 11.4 15-69(62)	1.2 ± 0.6 0.4-3.3(62)	8.6 ± 6.5 0-28(61)
37.3 ± 19.4 13-59(6)	47.7 ± 16.2 28-70(6)	15.0 ± 5.4 7-23(6)	5.0 ± 11.2 0-30(6)	10.0 ± 22.4 0-60(6)	30.2 ± 13.8 11-45(6)	2.1 ± 0.8 1.3-3.8(6)	6.3 ± 6.9 0.18(6)
29.1 ± 7.1 15-38(9)	59.1 ± 8.2 49-72(9)	11.8 ± 2.8 8-17(9)	9 ± 18 0-45(5)	7 ± 14 0-35(5)	20.0 ± 6.2 8-25(5)	3.6 ± 1.4 1.9-6.0(9)	4.6 ± 3.3 0-10(5)
18.5 ± 6.8 6-50(89)	65.8 ± 6.5 40-80(89)	15.7 ± 3.8 7-26(89)	42.5 ± 29.3 0-207(87)	36.6 ± 27.5 0-227(87)	12.0 ± 6.2 2-34(59)	3.0 ± 1.0 1.4-7.3(89)	1.6 ± 2.0 0-10(55)
11.5 ± 3.6 7-22(74)	60.4 ± 3.9 51-69(74)	28.0 ± 3.4 15-34(74)	59.2 ± 16.1 13-100(74)	40.6 ± 9.8 21-72(74)	4.9 ± 4.7 -3-20(74)	1.5 ± 0.3 1.0-3.1(74)	0.1 ± 0.5 0-3(75)
12.5 ± 4.2 3-40(359)	57.6 ± 4.4 42-74(359)	29.9 ± 3.4 12-39(359)	49.2 ± 15.1 10-98(359)	34.7 ± 11.5 0-82(359)	6.5 ± 4.6 -16-23(338)	1.3 ± 0.3 0.8-3.9(359)	0.1 ± 0.7 0-10(339)
13.6 ± 5.3 7-22(5)	59.4 ± 4.3 54-67(5)	27.0 ± 3.3 24-33(5)	32.2 ± 10.1 24-50(5)	31.6 ± 11.3 20-53(5)	--	1.5 ± 0.2 1.2-1.9(5)	-0- 0-0(5)
12.5 ± 6.5 3-30(32)	60.3 ± 7.6 45-76(32)	27.2 ± 4.1 17-36(32)	43.8 ± 18.7 0-115(32)	35.9 ± 14.9 0-97(32)	8.7 ± 4.7 -16-32(32)	1.5 ± 0.4 1-3(32)	0.3 ± 0.9 0-4(32)
23.7 ± 11.3 9-53(18)	49.3 ± 11.2 22-64(18)	26.9 ± 2.8 24-33(18)	31.9 ± 23.3 0-95(18)	21.3 ± 16.8 0-57(18)	15.1 ± 10.1 -7-32(18)	1.2 ± 0.3 1-2(18)	1.7 ± 2.4 0-9(18)
25.9 ± 8.1 5-48(97)	47.3 ± 6.3 29-61(97)	26.7 ± 4.8 16-45(97)	31.1 ± 13.4 0-61(97)	24.4 ± 11.9 0-45(97)	19.4 ± 7.0 0-36(93)	1.2 ± 0.3 0.5-1.8(96)	1.4 ± 1.6 0-9(93)
30.3 ± 8.8 6-64(124)	42.3 ± 7.3 17-59(124)	27.4 ± 6.0 16-51(124)	23.7 ± 14.2 0-48(124)	21.0 ± 12.9 0-50(124)	23.8 ± 5.8 10-45(120)	1.1 ± 0.3 0.4-2.0(124)	1.9 ± 2.0 0-8(120)
18.8 ± 7.2 12-51(36)	51.8 ± 6.5 31-62(36)	29.5 ± 5.0 18-46(36)	21.3 ± 14.7 0-48(36)	15.6 ± 12.3 0-37(36)	16.0 ± 6.4 7-37(36)	1.2 ± 0.2 0.6-1.7(36)	0.8 ± 1.9 0-10(36)
19.4 ± 15.1 2-45(19)	42.9 ± 18.7 16-85(19)	37.7 ± 11.9 9-59(19)	3.2 ± 9.5 0-35(19)	1.9 ± 8.3 0-37(19)	15.2 ± 15.4 -14-16(14)	1.0 ± 1.3 0.2-6.0(19)	0.6 ± 1.6 0-7(19)
27.9 ± 11.2 15-44(9)	42.7 ± 8.3 31-54(9)	29.4 ± 4.9 25-41(9)	14.6 ± 16.5 0-38(9)	8.9 ± 12.6 0-30(9)	--	1.0 ± 0.2 0.7-1.4(9)	2.6 ± 2.9 0-7(9)
22.7 ± 7.3 13-34(13)	42.2 ± 6.2 34-51(13)	35.2 ± 6.6 22-46(13)	18.8 ± 21.0 0-80(13)	9.5 ± 12.0 0-40(13)	18.4 ± 7.5 3-30(13)	0.9 ± 0.3 0.5-1.4(13)	2.8 ± 3.8 0-12(13)
43.0 ± 13.0 13-60(14)	31.9 ± 9.0 23-59(14)	25.1 ± 6.4 15-42(14)	-0- 0-0(14)	-0- 0-0(14)	32.6 ± 10.4 8-48(14)	0.9 ± 0.2 0.6-1.4(14)	5.1 ± 3.0 0-9(14)
21.8 ± 7.0 10-40(24)	60.0 ± 6.3 45-70(24)	18.2 ± 5.2 10-30(24)	29.4 ± 15.5 4-63(21)	13.6 ± 7.5 0-30(22)	--	2.4 ± 0.8 1.2-4.3(24)	1.3 ± 1.1 0-3(6)
8.3 ± 4.0 4-20(18)	62.8 ± 4.7 56-70(18)	28.9 ± 3.8 22-36(18)	30.4 ± 13.2 13-70(18)	13.4 ± 5.9 7-34(18)	13.7 ± 2.7 9-8(6)	1.5 ± 0.3 1.1-1.9(18)	-0-
13.6 ± 9.2 1-37(21)	49.0 ± 10.0 30-66(21)	37.4 ± 8.7 14-49(21)	8.9 ± 13.0 0-38(21)	10.5 ± 14.4 0-40(21)	12.0 ± 12.4 -14-31(21)	1.0 ± 0.6 0.5-2.8(21)	0.2 ± 0.4 0-1(21)

The coefficient is a relative measure of sorting, and takes into account the weight of coarser fragments with diameters less than the inside diameter (about 1.8 inches) of the sampler; the larger the coefficient, the more poorly sorted (or well-graded) is the grain-size distribution of the sample.

PREVIOUS WORK

MacClintock (1929) described several sections east of the study area along Big Creek and Mill Creek (fig. 1). Except for stratigraphic names later designated by Jacobs and Lineback (1969) and formalized by Willman and Frye (1970), his descriptions and interpretations are valid. He found a thick, pre-Illinoian paleosol (the Yarmouth Soil) developed in wood-bearing till, referred to as the Casey till member of the Banner Formation by Ford (1970). MacClintock noted that the top of the paleosol often is covered by a thin, fossiliferous, silty unit (Smithboro Till Member of the Glasford Formation), which in turn is overlain by the uppermost Illinoian unit of the area, a loam till (Vandalia Till Member of the Glasford Formation). The Sangamon Soil is developed in the upper part of the Illinoian deposits. Wisconsinan loess covers the Illinoian deposits in nearly all places.

As more of the central Illinois region was explored, the geologic units were described and given informal names (e.g. Jacobs and Lineback, 1969; Ford, 1970). Willman and Frye (1970) formalized the names and designated type sections; Follmer et al. (1979) summarized regional relationships, and described the type area of the Sangamon Soil. Unpublished theses provide additional stratigraphic and mineralogical information on Illinoian and pre-Illinoian deposits in central Illinois (Kettles, 1980; Hartline, 1981; Fox, 1987) and Holocene deposits elsewhere in the state (Stanke, 1988; Hajic, 1990). These studies set the regional framework for recognition of stratigraphic units at the MAS. Recent reports by Battelle Memorial Institute and Hanson Engineers (1988, 1990a, b) describe the geology of the MAS, independent of this report.

BEDROCK LITHOLOGY, STRUCTURE, AND TOPOGRAPHY

Bedrock Lithology and Structure

The bedrock immediately underlying the MAS consists of Pennsylvanian sandstone, silty sandstone, and some shale, limestone, and coal. These rocks are part of the Modesto Formation and the overlying Bond Formation. The strata dip about 0.5°east or 50 feet per mile along the east flank of the La Salle Anticlinal Belt (Battelle Memorial Institute and Hanson Engineers, 1990a). At the MAS, sandstone is the most common lithology at the bedrock surface.

The bedrock immediately underlying the glacial drift is commonly gleyed and weak, and contains discontinuities in the uppermost 3 feet, especially along bedding planes. The material generally is dolomitic and contains no clay minerals or structures typical of weathering profiles, which indicate that the weak character is diagenetic.

Bedrock Topography/Drift Thickness

Horberg (1950) mapped the topography of the bedrock surface in Illinois, and Piskin and Bergstrom (1975) mapped drift thickness. However, at the time of their mapping, the number of reliable data points in Clark County was small. Horberg mapped a deep buried bedrock valley adjacent to the MAS that nearly coincides with the present-day North Fork Embarras River valley (fig. 3). The valley begins northwest of the MAS, and is a tributary of a larger buried valley system that extends south and east. Test drilling for characterizing the MAS revealed, in addition to Horberg's original valley, another deep bedrock valley extends beneath the MAS. Current interpretation of the region's bedrock topography is shown in figure 4. Thin drift covers a bedrock-cored moraine (Mickelson et al., 1983) that is present east of the MAS (fig. 1), as interpreted from surface topography, distribution of bedrock outcrops (Horberg, 1950) and reconnaissance borings for this study.

The bedrock topography beneath and adjacent to the MAS is characterized by north-south trending ridges and two buried valleys, informally referred to as the MAS and North Fork Embarras buried valleys (fig. 5). Under the MAS, drift thickness varies from about 75 feet on the northwest

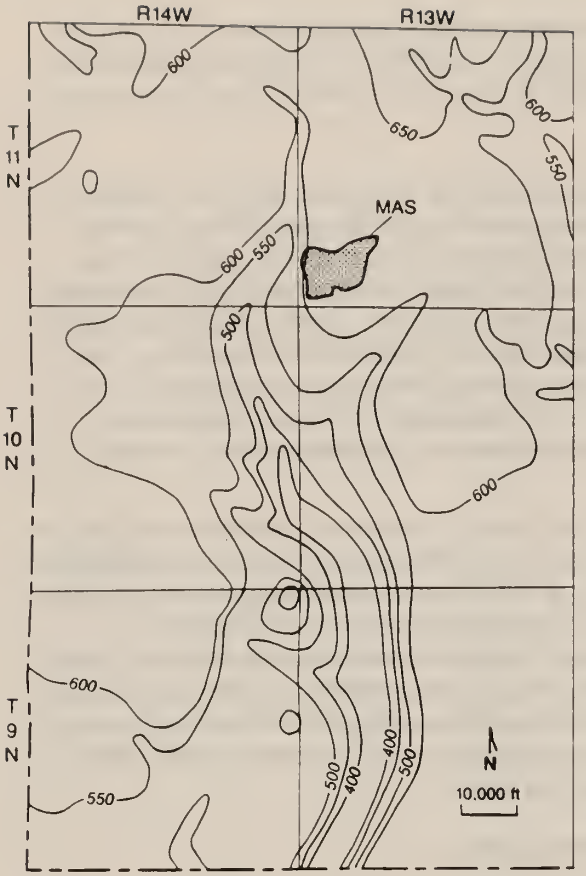


Figure 3 Bedrock topography of part of Clark County as mapped by Horberg (1950).

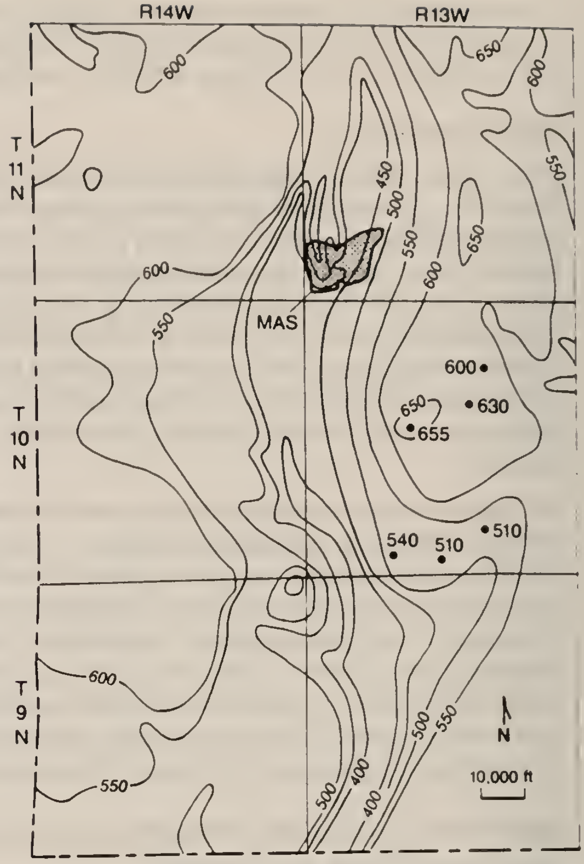


Figure 4 Reinterpretation of bedrock topography shown in figure 3 based on test drilling for the MAS.

and east to more than 200 feet within the MAS buried valley (fig. 6). The drift is as little as 20 feet thick beneath the mouth of Bluegrass Creek adjacent to the MAS.

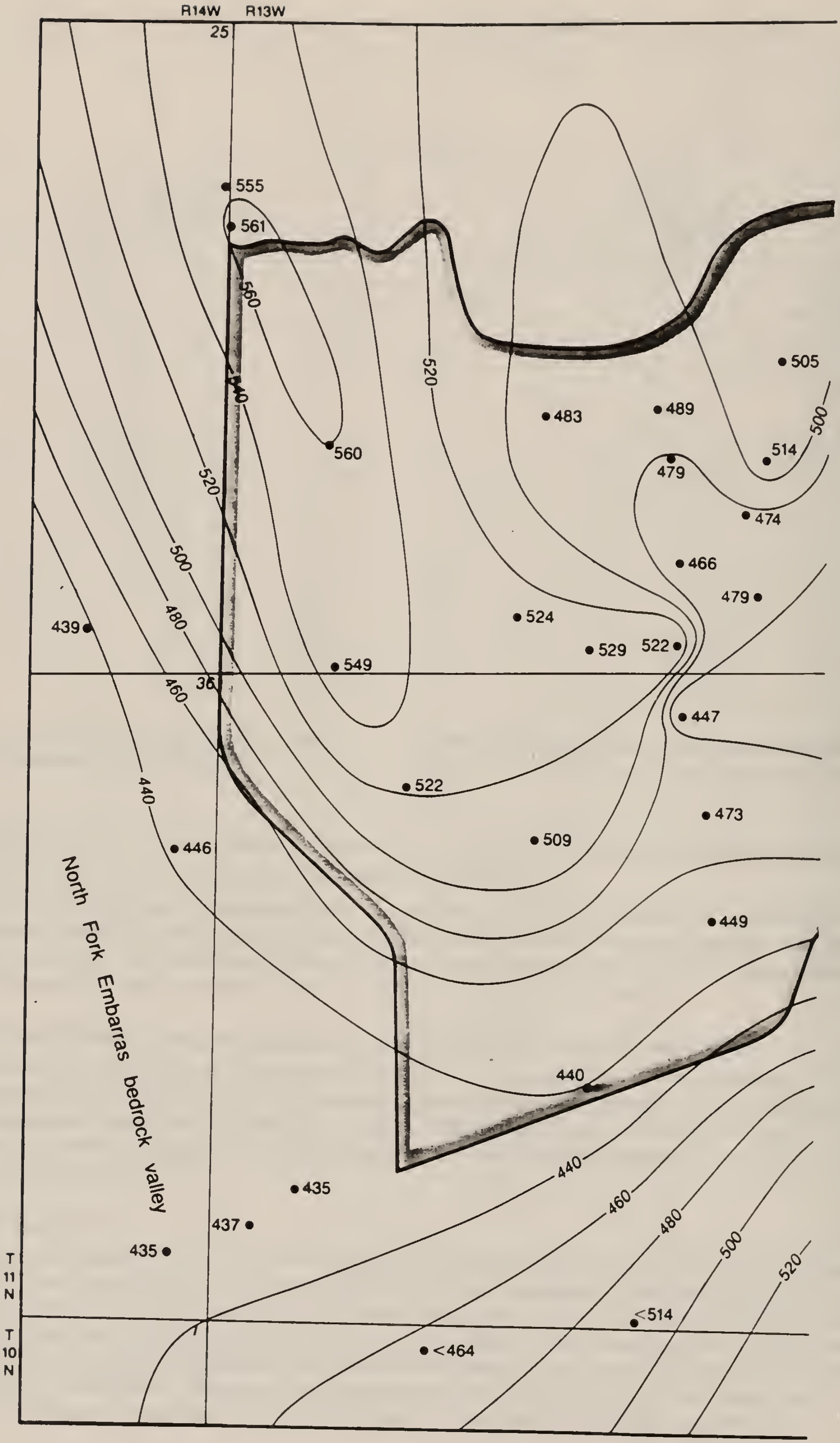
Bedrock was encountered in 42 continuously sampled borings. In 21 of these, 5 feet or more of bedrock was penetrated and sampled. The lowermost drift, locally composed of alluvium and colluvium, is composed of mostly local bedrock, making determination of the bedrock surface difficult in a few places. Contacts between till units and bedrock generally are sharp.

LITHOSTRATIGRAPHY AND PEDOSTRATIGRAPHY OF QUATERNARY DEPOSITS

This section describes physical characteristics, thickness and distribution of the Quaternary lithostratigraphic units. Description of pedostratigraphic units as they generally occur within the lithostratigraphic framework is included to maintain overall continuity of this section. Figure 7 provides a summary description of the stratigraphic units and derivative facies found in north-central Clark County.

Banner Formation

The Banner Formation, the oldest known Quaternary lithostratigraphic unit in Clark County, is less than 2 feet thick at the MAS, but it is more than 30 feet thick elsewhere in the study area (fig. 1). As defined by Willman and Frye (1970), the Banner Formation overlies the Afton Soil and underlies either Petersburg Silt or the Glasford Formation. Yarmouth Soil is developed in the upper part of the Banner. However, the stratigraphic position of the Afton Soil at its type locality in Afton Junction, Iowa, is controversial. The age of pre-Yarmouthian deposits, once called Nebraskan, Aftonian, and Kansan, is regarded now as pre-Illinoian in Iowa (Hallberg, 1986), an informal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North Fork Embarras bedrock valley
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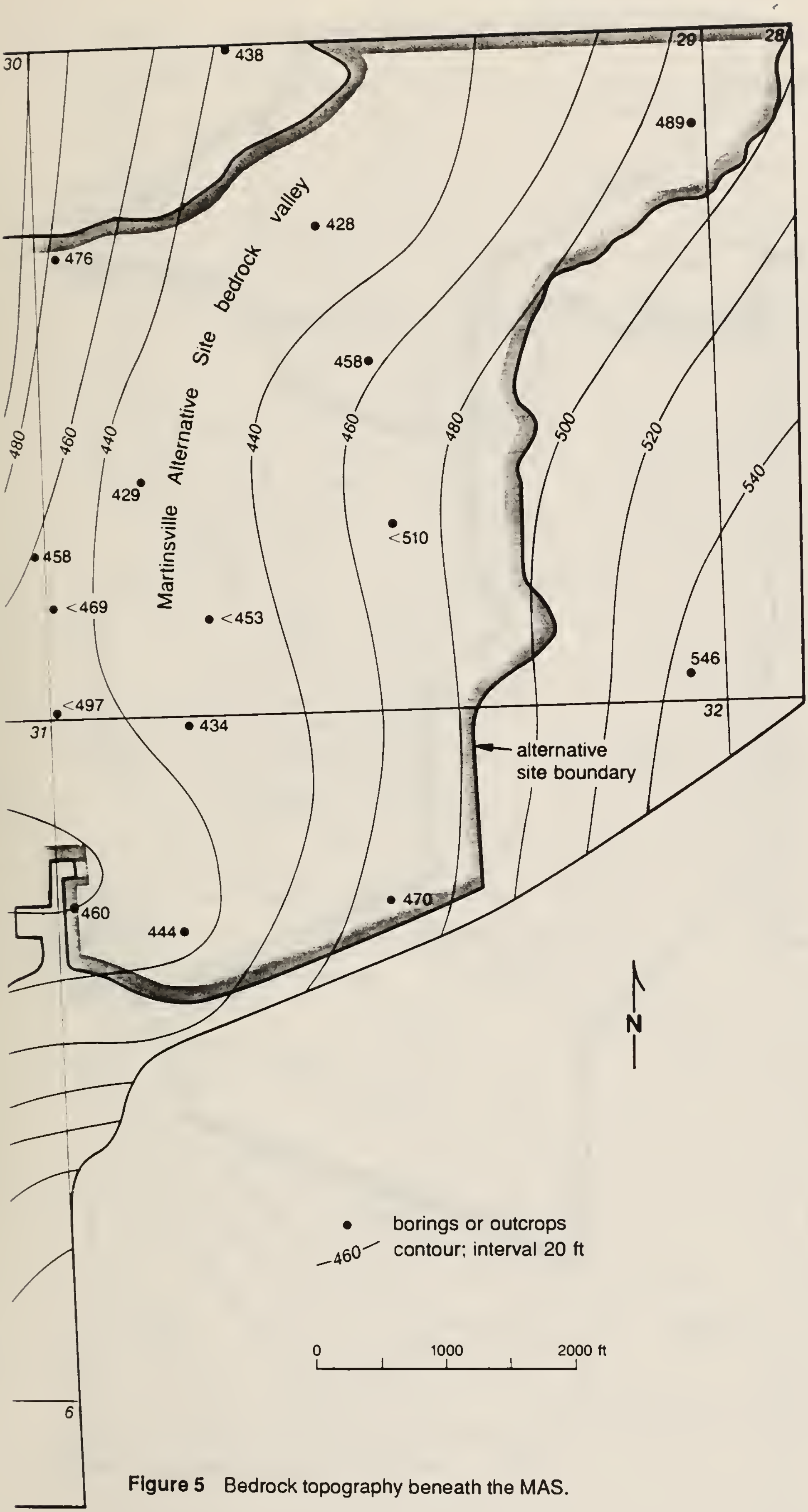
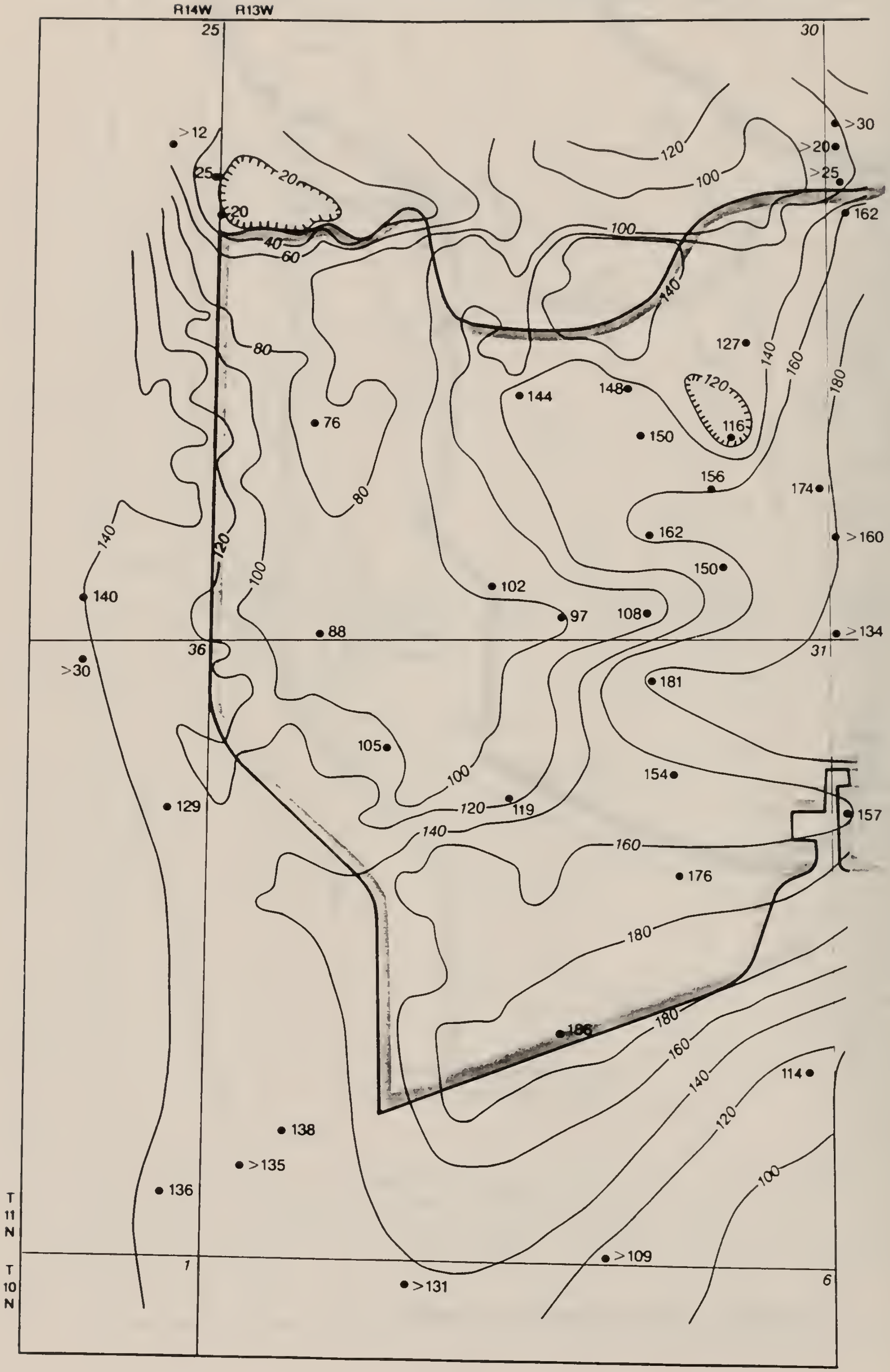


Figure 5 Bedrock topography beneath the MAS.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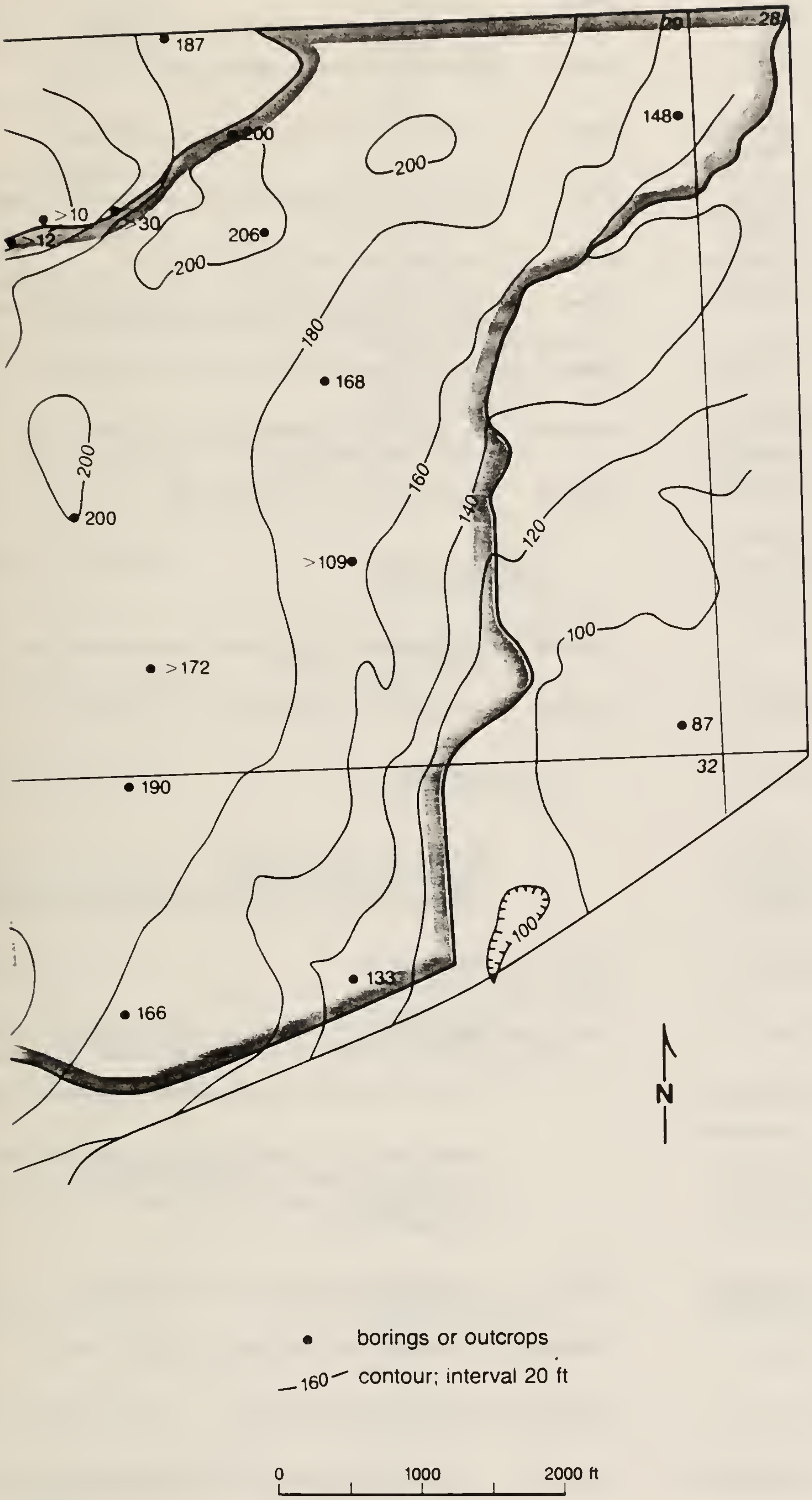


Figure 6 Thickness of glacial drift at the MAS.

Unit (symbol)	Age	*Pedostratigraphic unit	Color of fresh core or outcrop (Munsell notation)
Lacon Formation (l)	Holocene	Modern	Grayish brown (10YR 5/2), yellowish brown (10YR 5/4)
Peyton Colluvium (pey)	Wisconsinan, Holocene	Modern	Grayish brown (10YR 5/2), Brownish yellow (10YR 6/6)
Cahokia Alluvium (c)	Holocene, Wisconsinan	Modern	Grayish brown (2.5Y 5/2), gray (N 4/0), yellowish brown (10 YR 5/4), dark gray (10YR 4/2)
Parkland Sand (pks)	Wisconsinan	Modern	Very pale brown (10YR 7/3), light gray (N 6/0)
Peoria Loess (p)	Wisconsinan	Modern	Light brownish gray (10YR 6/2), very pale brown (10YR 7/3), dark grayish brown (10YR 4/2), light gray (2.5Y 7/2), black (10YR 2/1)
Roxana Silt (r)	Wisconsinan	Farmdale	Light pinkish gray (7.5YR 6/1), yellowish brown (10YR 5/8), black (N 2/0)
Berry Formation (b)	late Illinoian, Sangamonian	Sangamon	Dark gray (2.5Y 4/1), gray (N 6/0), pinkish gray (7.5YR 6/2), grayish brown (10YR 5/2), black (N 2/0)
Pearl Formation (pe)	late Illinoian	Sangamon	As above, and strong brown (7.5YR 4/6)
Glasford Formation	Illinoian		
Vandalia Till Mbr.			
mélange facies (gv-m)			Gray (N 5/0)
as above, B-horizon of Sangamon Soil (gv-mx)	-	Sangamon	Grayish brown (10YR 5/2), brownish yellow (10YR 6/6), red (2.5YR 4/8), black (5YR 2.5/1)
as above, C-horizon of Sangamon Soil (gv-mo)	-	Sangamon	Light yellowish brown (2.5Y 6/2), brown (10YR 5/3)
uniform diamicton facies (gv-u)	-		Gray (N 5/0)
Mulberry Grove Member	Illinoian	-	
sand and gravel facies (gm-z)	-		Gray (N 5/0), olive gray (5Y 5/2)
diamicton facies (gm-d)	Pike		Gray (N 5/0), greenish gray (5GY 5/1; rare)
silt loam facies (gm-s)	Pike		Olive gray (5Y 5/2), gray (N 5/0), dark grayish brown (2.5Y 4/2)
Smithboro Till Member	Illinoian		
loam diamicton facies (gs)		Pike (rare)	Gray (N 5/0)
silt loam diamicton facies (gs-s)		-	Gray (N 5/0; 5Y 4/1), very dark gray (10YR 3/1), dark grayish brown (2.5YR 4/2), dark olive grey (5Y 3/2), pale olive (5Y 6/3)
Petersburg Silt (ps)	Illinoian	**	Pale olive (5Y 6/3), dark olive gray (5Y 3/2), black (5Y 2.5/1)
Martinsville sand	early Illinoian		
silty clay facies (ms-s)		**	Greenish gray (5GY 6/1), dark greenish gray (7.5GY 4/1), dark grayish yellow (5Y 4/3), red (10YR 4/6), black (N 2/0)
sand and gravel facies (ms-z)	**		Olive gray (5Y 5/2), grayish brown (2.5Y 5/2)
diamicton facies (ms-d)	-		Olive gray (5Y 4/2)
Banner Formation			
Lierle Clay Member (bl)	Yarmouthian	Yarmouth	Gray (N 5/0), olive gray (5Y 5/2), brown (10YR 5/3)
Casey till member (bc)	pre-Illinoian	-	Gray (N 4.5/0, 5Y 4.5/1)
as above, B-horizon of Yarmouth Soil (bc-x)	-	Yarmouth	Grayish brown (10YR 5/2), yellowish brown (10YR 5/6)
as above, C-horizon of Yarmouth Soil (bc-o)	-	Yarmouth	Light yellowish brown (10YR 6/4)
Modesto and Bond Formations (Pb)	Pennsylvanian	Yarmouth	Light brownish gray (10YR 6/2), very dark grayish brown (2.5Y 3/2), black (N 2/0), for example

*generally, but not necessarily associated with lithostratigraphic unit
**associated with no named soil stratigraphic unit, but possesses leached, organic-rich horizons and fragments of wood
***notation from Buol et al., 1980

Figure 7 Quaternary lithostratigraphic units of north-central Clark County and the Martinsville Alternative Site. Symbols for units are used in all figures of cross sections and lithofacies logs.

Plasticity, moist consistence***	Discontinuities	Description (thickness, feet)
Plastic to slightly plastic, friable	Pedogenic; roots, burrows, peds, etc.	Loam diamicton, silt loam (0-4)
Slightly plastic, friable	Pedogenic	Silt loam, loam diamicton (0-4)
Plastic to nonplastic, loose to friable	Pedogenic	Interbedded gravel, fine- to medium-grained sand and silt loam (
Slightly plastic, very friable	Pedogenic	Fine grained sand (0-7)
Plastic, friable to firm	Pedogenic	Silty clay, silt loam (0-7)
Plastic, firm	Pedogenic, including krotovina, large Mn nodules and concretions	Loam (1-4)
Plastic, firm	Pedogenic as above	Silty clay loam, clay loam, loam diamicton (3-12)
Nonplastic to plastic, loose to firm	Lithologic	Gravelly sand, fine-grained sand, silty clay (0-13)
Slightly plastic, firm to extremely firm	Lithologic: sand-filled joints, healed fractures, and faults	Chiefly loam diamicton, with less gravelly sand, sand, and subordinate silt (0-26)
Plastic, firm	As above, but pedogenically modified	As above, but leached, and with pedogenic features (0-2)
Sightly plastic, firm to extremely firm	As above	As above, but leached along discontinuities, and with pedogenic features (0-10)
Slightly plastic, extremely firm	Lithologic discontinuities as above, but less frequent	Loam diamicton, less amounts of sand and gravel (0-129)
Nonplastic, loose	Lithologic	Sandy loam to sorted sand and gravel (0-31)
Slightly plastic, extremely firm	Lithologic	Loam diamicton (<10)
Slightly plastic to plastic, firm	Lithologic	Silt loam, silt (0-10)
Slightly plastic, firm	Healed fractures, sand-filled joints, infrequent vertical pedogenic cracks	Loam diamicton (0-44)
Slightly plastic to plastic, firm to extremely firm	Horizontal shear planes separating lithologic discontinuities	Silt loam diamicton (0-58)
Nonplastic to slightly plastic, firm	-	Silt loam, silt, fine- to coarse-grained sand (0-50)
Plastic, firm to extremely firm	Lithologic	Silt clay, clay loam (0-4)
Nonplastic, loose	Lithologic	Sand and gravel (0-25)
Plastic, firm	Lithologic	Sandy loam diamicton (0-9)
Plastic, firm	Lithologic	Silty clay, silty clay loam (0-6)
Slightly plastic, extremely firm	Lithologic, including sand-filled joints, healed fractures	Loam, clay loam diamicton (0-30)
Plastic, firm	As above, with pedogenic alteration	As above, but leached and with pedogenic features (0-5)
Slightly plastic, extremely firm	As above, with pedogenic alteration	Loam diamicton (0-5)
Nonplastic to slightly plastic, firm to extremely firm	Lithologic	Sandstone, siltsone, mudstone, limestone, coal

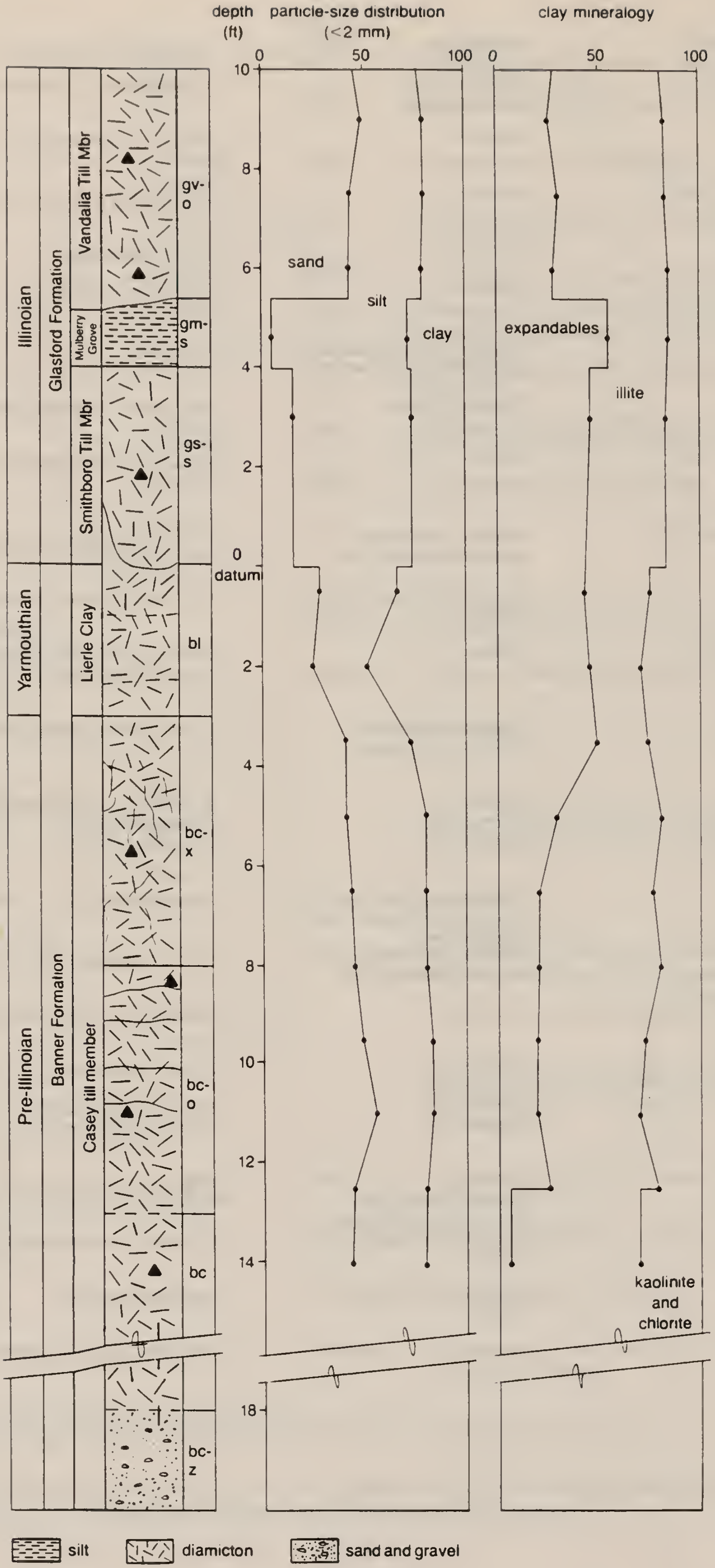


Figure 8 Lithofacies log and laboratory data, particle-size determinations, and clay mineralogy of outcrop samples collected at outcrop CC-11 (see fig. 1 for location). Total hydrolysate measurement of 0.17 is the mean of three analyses of *Hendersonia* shells from the Smithboro Till Member (McCoy, personal communication). Triangle denotes a relative abundance of > 2 mm fragments per unit.

convention that has been adopted in Illinois (Johnson, 1986). The Casey till member of the Banner Formation (described below) contains abundant wood fragments, indicating that a pre-Yarmouthian soil once occupied the area or may be present locally.

Casey Till Member The Casey till member of the Banner Formation was described and informally named by Ford (1970), but Kettles (1980) correlated the unit in the study area (on the basis of particle-size distribution and semiquantitative clay mineralogy) with the Hillery till member of the Banner Formation described near Danville, Illinois (Johnson et al., 1972). Because the regional distribution of the Hillery till member is not well known, we retain Ford's informal nomenclature.

The Casey is composed of grey loam to clay loam diamicton with mean percentages of sand, silt, and clay at 38, 38, and 24, respectively. It has a mean clay mineral composition of 8 percent expandables, 63 percent illite, and 29 percent chlorite and kaolinite (bc in table 1). The particle-size distribution of the Casey is consistent at any section (appendix), but it is regionally variable (Kettles, 1980). The mineralogy of the fine sand fraction (0.25 to 0.125 mm) of pre-Illinoian tills in northern Clark County indicates deposition of the till by the Huron-Erie Lobe of the Laurentide Ice Sheet (Fox, 1987). Sediments deposited by the Huron-Erie Lobe are differentiated from Lake Michigan Lobe deposits by a greater content of magnetic minerals, plagioclase, and calcite (Johnson, 1964; Fox, 1987). Willman et al. (1963) suggested that a calcite-to-dolomite ratio greater than 1 (as measured by X-ray diffraction techniques) is indicative of pre-Illinoian (Kansan) tills in Illinois; however, our study shows that Illinoian tills in Clark County also possess this character.

Although not observed at the MAS, Casey till has been identified east and west of the MAS in outcrops CC-8 and CC-11 near Mill Creek, and at CC-20 north of Casey, Illinois (fig. 1). The unit is at least 30 feet thick at CC-11. At outcrops the Casey is commonly oxidized (Kettles, 1980; oxidized samples are denoted bc-o in table 1 and the appendix). The oxidized diamicton generally is yellow-brown to brown and has irregular oriented fractures with sand fillings as much as 0.25 in thick. The oxidization is considered part of the C1, C2 and/or C3 horizons of the Yarmouth Soil (soil horizon designations after Follmer, 1985).

An accessible exposure of the Casey till member in Clark County is along Hurricane Creek at CC-11 (figs. 1 and 8) at or near Location 7 of MacClintock (1929). The upper 3 to 5 feet of the Casey is leached, reddish brown clay loam diamicton with well-developed, pedogenic subangular, blocky structure and abundant, continuous clay cutans. Below the leached zone is about 5 feet of oxidized diamicton with numerous horizontal, platy joints with sesquioxide coatings, and at least 3 feet of unoxidized, wood-bearing diamicton. MacClintock (1929) described 20 feet of sand and gravel above bedrock and below the diamicton, but presently it is not exposed at the outcrop. CC-11 is the only location in Clark County where thick sand and gravel is known to be associated with the Casey till member.

Lierle Clay Member Willman and Frye (1970) named and described the Lierle Clay as a member of the Banner Formation in west-central Illinois. The unit is composed of soft, leached diamicton, clay and silty clay that commonly becomes finer upward (bl in figs. 8 and 9). The mineralogy is dominated by smectite and also contains interstratified clay minerals and no chlorite. The Lierle is interpreted to have been deposited as pedogenically altered colluvium, alluvium, or as lacustrine sediment. This kind of deposit has been called "accretion gley" (eg., Willman et al., 1963; Willman and Frye, 1970).

At the MAS, Lierle Clay was identified in core from borings M-02, M-11 and M-105. In each case, the Lierle is less than 2 feet thick, and is overlain by the silt diamicton facies of the Smithboro Till Member of the Glasford Formation. Thus, its stratigraphic relationship with the Martinsville sand (described below) is unknown. Battelle Memorial Institute and Hanson Engineers (1990a) includes the Lierle Clay as part of Pre-Illinoian Silt and Clay (table 2).

Lierle Clay, as much as 8.5 feet thick, occurs at CC-8 and CC-11 east of the MAS. The sequence comprises leached, dark grey, massive to crudely stratified silty clay (figs. 8 and 9). The material

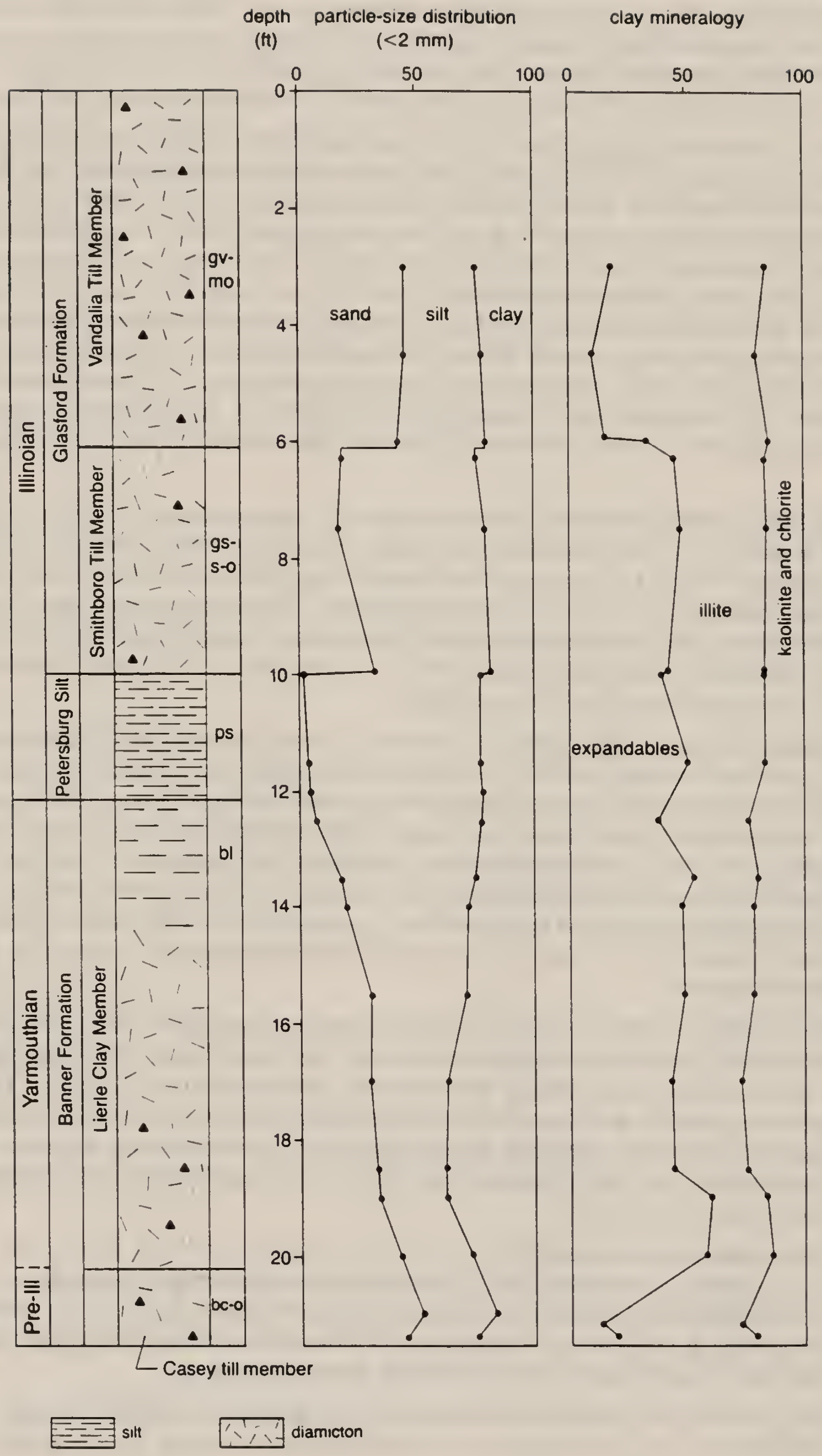


Figure 9 Lithofacies log and laboratory data from outcrop samples collected at CC-8. Triangle denotes a relative abundance of > 2 mm fragments per unit.

Table 2 Comparison of lithostratigraphy and stratigraphic nomenclature used in this report and Battelle Memorial Institute and Hanson Engineers (1990a)

Battelle 1990a	This report
Cahokia Alluvium	Cahokia Alluvium
Peyton Colluvium	Peyton Colluvium
Parkland Sand	Parkland Sand
Peoria Loess	Peoria Loess
not reported/not present at MAS	Wedron Formation
Roxana Silt	sandy silt facies of the Roxana Silt
Berry Clay	Berry Formation
Upper Sand	Pearl Formation
Glasford Formation	Glasford Formation
Vandalia Till Member	Vandalia Till Member
Fractured Vandalia Till	mělange facies
Vandalia Till Vandalia Sand	uniform diamicton facies
	Mulberry Grove Member
Sand Facies	silt facies, sand and gravel facies, diamicton facies
	Smithboro Till Member
Smithboro Till	loam diamicton facies and silt diamicton facies
Petersburg Silt	Petersburg Silt
	Martinsville sand
Basal Sand	sand and gravel facies
Pre-Illinoian Silt and Clay	silty clay facies diamicton facies
	Banner Formation
Pre-Illinoian Silt and Clay	Lierle Clay Member
not reported/not present at MAS	Casey till member

has numerous joints that are coated with sesquioxides, likely due to weathering at the face of the outcrop. The clay mineralogy is dominated by expandable clay minerals.

Yarmouth Soil

Yarmouth Soil was named by Leverett (1898), who described a buried soil from well cuttings at Yarmouth, Iowa, near the maximum extent of Illinoian glacial deposits. The Yarmouth Soil in Clark County is developed in Lierle Clay and the upper part of the Casey till member.

Pedogenic alteration of Lierle Clay and the Casey till member at CC-11 resulted in a 6- to 8-foot-thick leached zone and a 13-foot-thick oxidized zone (fig. 8). The upper Yarmouth (B horizon) at this site is reddish, with a subangular, blocky structure and continuous, thick, clay cutans. Diapiric intrusions of Lierle Clay into the overlying Smithboro Till Member suggest that the upper 3 feet of the Yarmouth soil was affected by soft sediment deformation, perhaps due to glaciotectonic deformation or loading (fig. 8). The clay content in the upper B horizon is 25 percent greater than the clay content in the oxidized or unaltered Casey diamicton below. The clay fraction contains abundant interstratified expandable clay minerals, no chlorite, and shows an upward decrease of illite, all characteristics of material that has been weathered in an interglacial pedogenic environment (Willman et al., 1963).

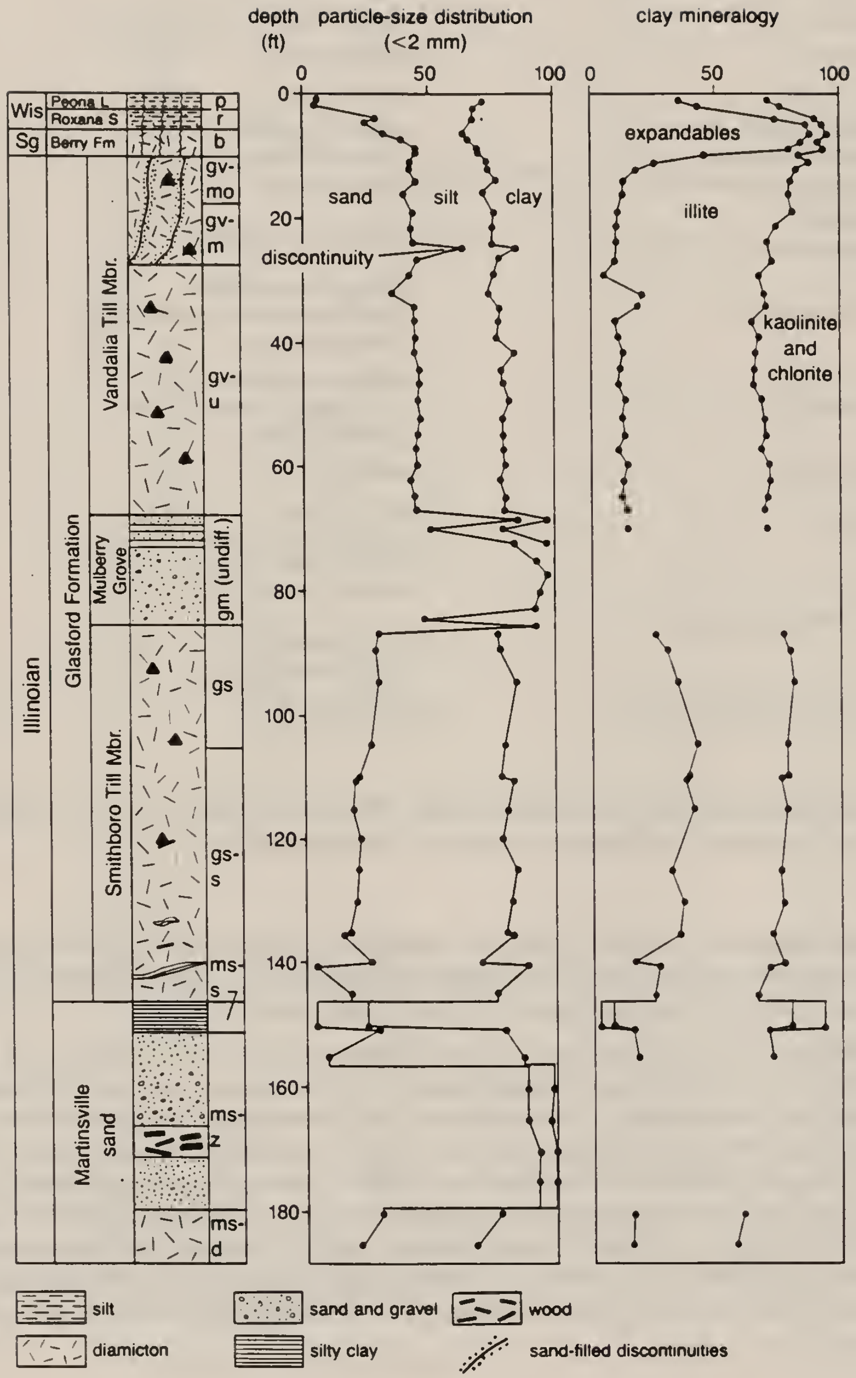


Figure 10 Lithofacies log and laboratory data from subsamples of core from CLK-02-02. Triangle denotes a relative abundance of > 2 mm fragments per unit.

The lower Yarmouth (C horizon) is composed of oxidized, sandy, and jointed material. Clay percentages do not increase in this horizon; the only clay mineral alteration is the transformation of chlorite to a vermiculitic phase that partly expands in an atmosphere saturated with ethylene glycol (see appendix; Willman et al., 1966). Whereas the contact between the B and C horizons is gradational, the contact between the C horizon and unaltered Casey diamicton (the C4 horizon of Follmer, 1985) is abrupt.

Martinsville Sand

Martinsville sand is an informal lithostratigraphic unit at the MAS that occurs above bedrock and below either the Petersburg Silt or the Smithboro Till Member of the Glasford Formation. Martinsville sand also was identified in CLK-03-01 south of Martinsville (fig. 1). The stratigraphic relationship of Martinsville sand with the Banner Formation, including the Lierle Clay, is unknown. Martinsville sand has three distinct intercalated facies: sand and gravel, loam diamicton, and silty clay, . The thickest and most continuous of these is the sand and gravel facies. Part of the unit is called Basal Sand and other parts are included in Pre-Illinoian Silt and Clay by Battelle Memorial Institute and Hanson Engineers (1990a,b,c; table 2 in this report).

Sand and gravel facies The sand and gravel facies (ms-z in table 1 and appendix) is as much as 25 feet thick at CLK-02-02 (fig. 10). The lithology of the gravel and coarser clastics is similar to the lithology of the diamicton facies. The sand and gravel facies may be continuous along the MAS and North Fork Embarras buried bedrock valleys. In the core for boring CLK-02-02, a bed about 3 feet thick is composed almost entirely of well-sorted, fine-grained sand and coniferous wood fragments (fig. 10).

Diamicton facies The diamicton facies (ms-d) is as much as 9 feet thick and found in core from borings CLK-02-02 and CLK-01-02. The facies is composed of distinctive dark olive green to grey sandy loam diamicton. The <2 μm fraction contains abundant kaolinite and chlorite, a characteristic of much of the underlying bedrock. The provenance of the coarse fragments is mostly local bedrock, but pebbles composed of quartz, quartzite, and polymineralogic lithologies with provenance from the upper Great Lakes or Canadian Shield suggest that at least some of the material is reworked from pre-Illinoian glaciogenic sediments.

Silty clay facies The silty clay facies (ms-s) ranges from loam to clay, but is silty clay at most places. The unit is as much as 4 feet thick at boring CLK-03-01. In core this facies has contrasting colors, commonly greenish gray (5GY 6/1; Munsell notation) and red (10R 4/6). Contacts between the colors are sharp, and color segregations are either uniform or mottled. Clay content, as much as 76 percent (fig. 10), is the highest measured for any geologic unit described in this study. The silty clay facies commonly overlies the sand and gravel facies; however, thin interbeds of fine- to medium-grained sand occur within the silty clay.

Petersburg Silt

Petersburg Silt was described and named in central Illinois by Willman et al. (1963). Petersburg Silt at the MAS is composed of brown, laminated (often rhythmically) or uniform, fossiliferous silt loam, and less commonly, well-sorted, very fine- to coarse-grained sand. The Petersburg occurs below an elevation of about 505 feet in the bedrock valleys (figs. 11, 12, and 13), where it is as much as 50.4 feet thick at M-125, the thickest known occurrence of this unit in Illinois. The mean thickness at the MAS is 5.7 feet. East of the MAS, the Petersburg generally is absent or less than about 2 feet thick, as at CC-8 (ps in fig. 9). Commonly, this unit is difficult to distinguish from the silt loam diamicton facies of the Smithboro Till Member of the Glasford Formation. The Petersburg contains abundant coniferous wood fragments, and few gastropod shells, including *Stenotrema, Hendersonia,* and *Succinea.* The mean sand, silt, and clay content is 11, 67, and 22 percent, respectively (table 1). The semiquantitative mineralogic analyses of the <2 μm fraction show the Petersburg is composed of a mean 19 percent expandables, 52 percent illite, and 29 percent kaolinite and chlorite; unoxidized samples are composed of about 12 percent expandables, 57 percent illite and 31 percent kaolinite and chlorite.

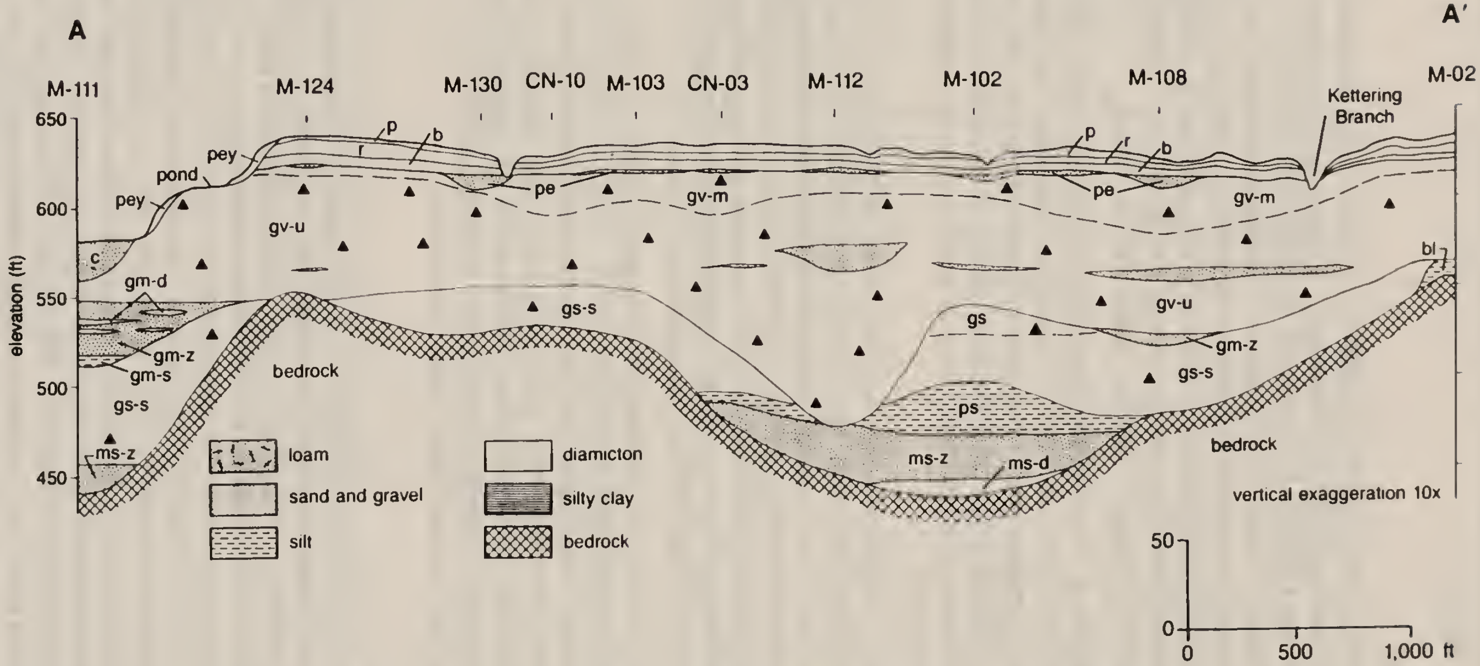


Figure 11 Cross section A-A′. Section location on figure 2. All borings extend to bedrock. Triangles denote the relative abundance of >2 mm fragments per unit.

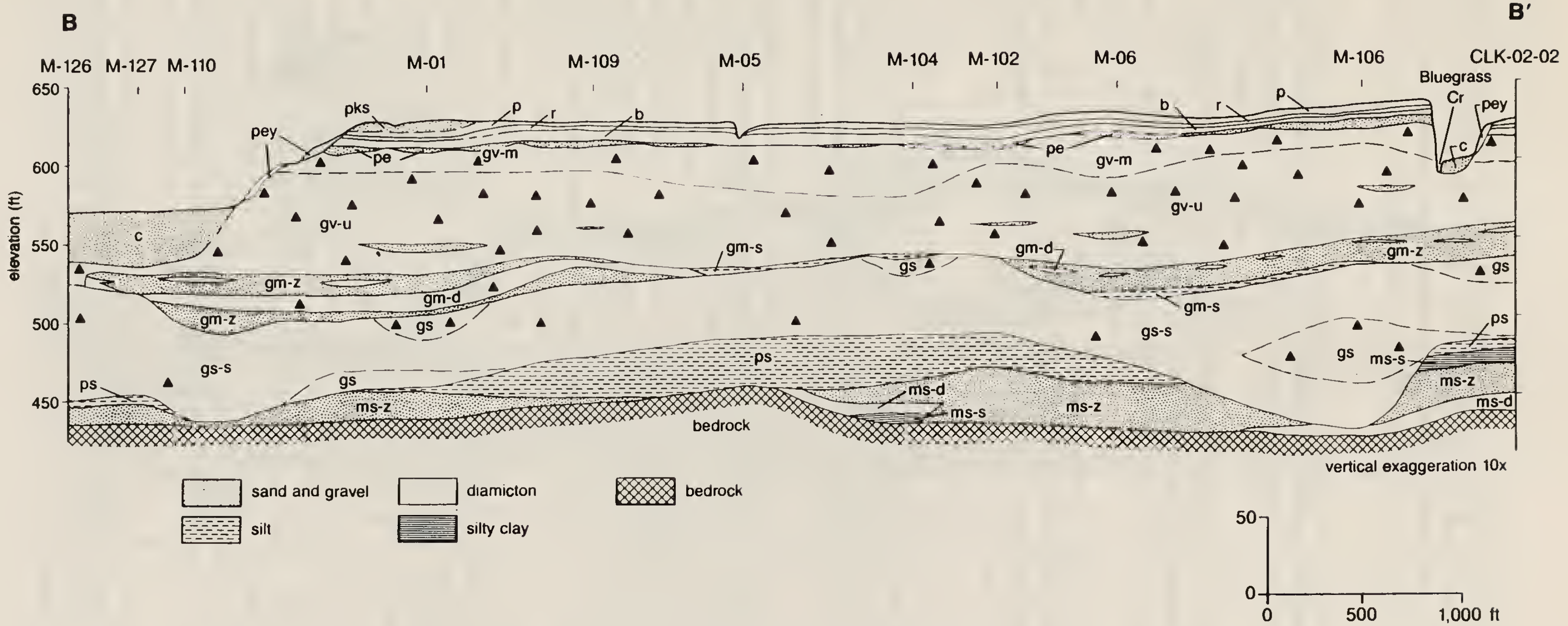


Figure 12 Cross section B-B′. Section location on figure 2. All borings extend to bedrock. Triangles denote the relative abundance of >2 mm fragments per unit.

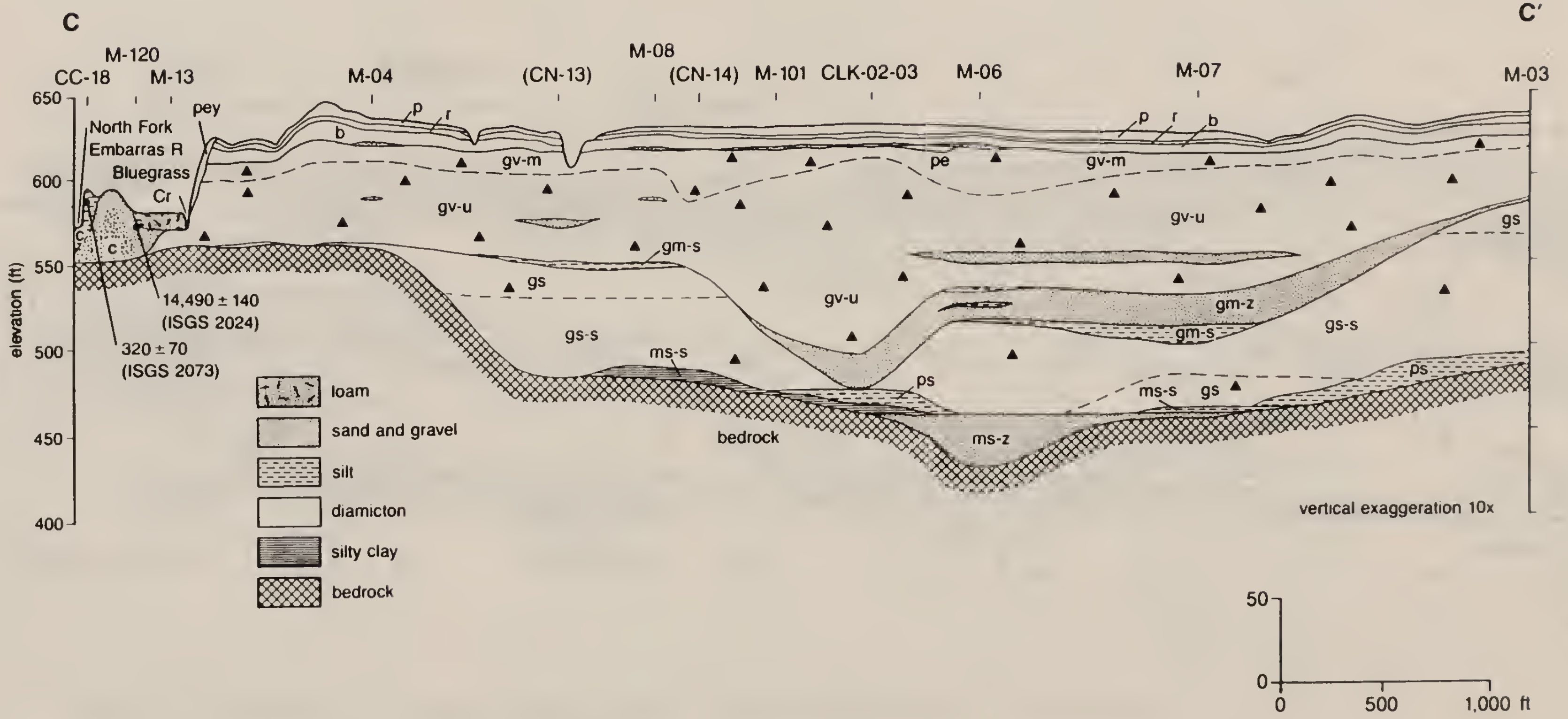


Figure 13 Cross section C-C′. Section location on figure 2. All borings extend to bedrock. Triangles denote the relative abundance of >2 mm fragments per unit.

Glasford Formation

The Glasford Formation, named and described by Willman and Frye (1970), has three members in north-central Clark County. In ascending order, the members are the Smithboro Till, Mulberry Grove, and Vandalia Till. These units overlie the Banner Formation, Martinsville sand, and Petersburg Silt, and underlie Pearl Formation, Berry Formation, Peyton Colluvium and Cahokia Alluvium.

In this report, the Berry is considered a formation, and not a member of the Glasford Formation as originally defined by Willman and Frye (1970). This revision is necessary at the MAS because a persistent layer of sand and gravel, correlated with the Pearl Formation, underlies the Berry Formation, and overlies the Vandalia Till Member.

Jacobs and Lineback (1969) initially described the members of the Glasford Formation east of the Illinois River near Vandalia, Illinois. The units were formally named by Willman and Frye (1970). The Glasford is at least 180.4 feet thick in the MAS buried valley; about 25 feet is exposed in several outcrops adjacent to and east of the study area.

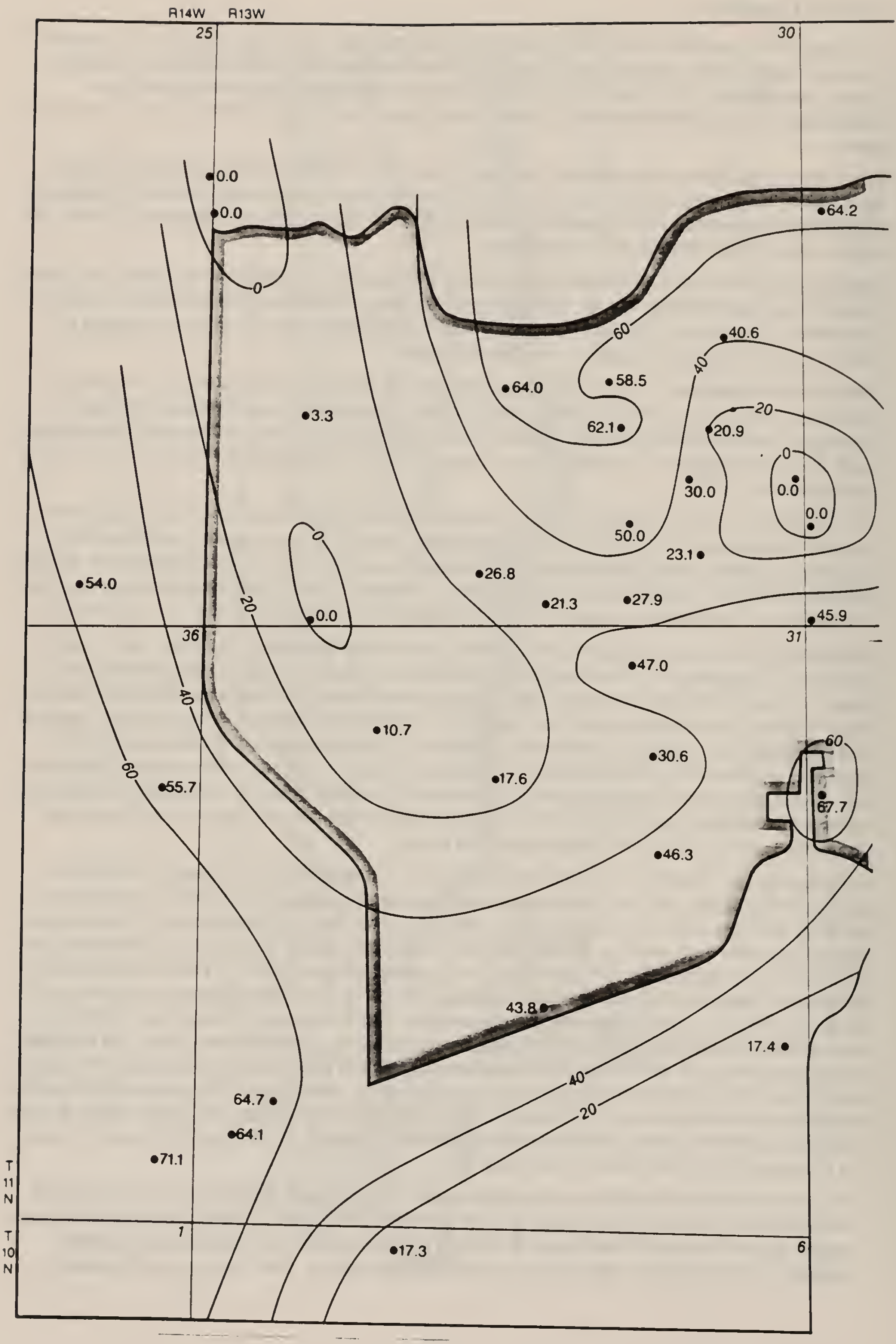
Smithboro Till Member At the MAS the Smithboro Till Member of the Glasford Formation is composed of silt loam to loam diamicton, and commonly contains wood fragments and rare gastropod shells, especially where it is silty. The mineralogy of the fine-grained sand fraction indicates that the Smithboro Till Member was deposited by the Lake Michigan Lobe of the Laurentide Ice Sheet (Fox, 1987).

The Smithboro is not exposed at ground surface at the MAS, but it is as much as 97 feet thick in the MAS buried bedrock valley at boring M-106 (figs. 14 and 15), the thickest occurrence yet described in Illinois. Mean thickness of the Smithboro is 28 feet at the MAS. Elsewhere in Illinois, the Smithboro is not known to exceed a thickness of about 10 feet. The Smithboro truncates the Petersburg Silt and Martinsville sand at several localities under the MAS (figs. 11, 12, and 13).

An arbitrary textural boundary differentiates two facies of the Smithboro. Samples with a sand content of 24 percent or less are assigned to the silt loam diamicton facies, and samples with at least 25 percent sand are assigned to the loam diamicton facies. The silt loam diamicton facies (gs-s in table 1) is composed of silt loam diamicton, including abundant wood fragments, uniform and laminated silt, and gleyed sandstone, as well as uncommon gastropod shells and folded beds and laminae of silt and silty clay. The inclusions are composed of both Petersburg Silt and silty clay facies of the Martinsville sand. The silt loam diamicton facies is commonly overlain by or interbedded with the loam diamicton facies (gs in table 1) that contains fewer wood fragments and deformed inclusions than the silt diamicton facies.

In some borings, trends in grain-size distribution of the Smithboro are gradational as shown in data from CLK-02-02 (fig. 10), but at other locations, abrupt changes occur from one facies to another, such as in core from borings M-07 (fig. 15) and M-106 (fig. 16; appendix). The silt loam diamicton facies is as much as 58 feet thick at boring M-03, and contains a mean grain-size distribution of 18 percent sand, 57 percent silt, and 25 percent clay (table 1). The loam diamicton facies is as much as 44 feet thick at boring M-02, and contains a mean grain-size distribution of 32 percent sand, 45 percent silt, and 23 percent clay. The mineralogy of the <2 μm fraction between the two facies also is different: the mean percentages of expandables, illite, and kaolinite and chlorite in the silt loam diamicton facies are 30, 42, and 28, respectively, whereas the loam diamicton facies has mean percentages of 26, 47, and 27, respectively. The carbonate content of the Smithboro, as determined by X-ray diffraction, is less in the silt loam diamicton facies than in the loam diamicton facies (mean values of calcite and dolomite are 23.7 and 21.0 vs. 31.1 and 24.4 counts per second, respectively; table 1).

The silt loam diamicton and loam diamicton facies have markedly different physical properties. Mineralogic and textural data indicate that the silt diamicton facies contains more silty and clayey sediment from reworked Petersburg Silt, as well as more weathered, fine-grained sediment (probably including Lierle Clay) than the loam diamicton facies. The mean moisture content is



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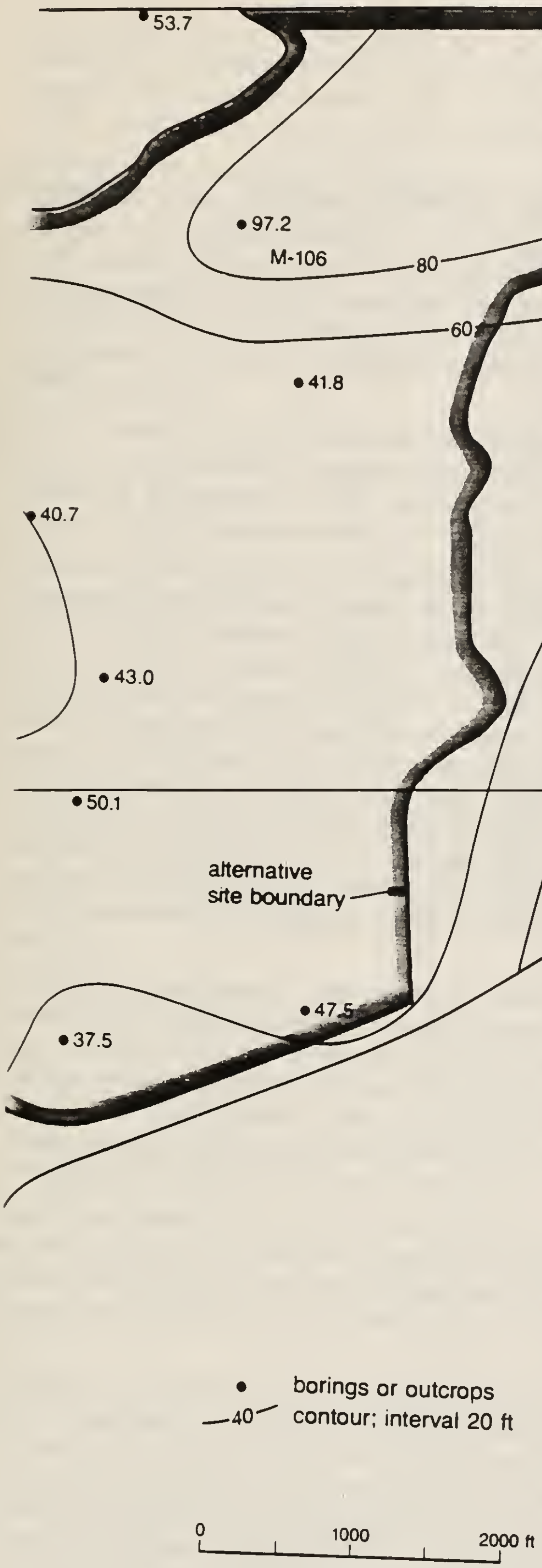


Figure 14 Thickness of the Smithboro Till Member, Glasford Formation.

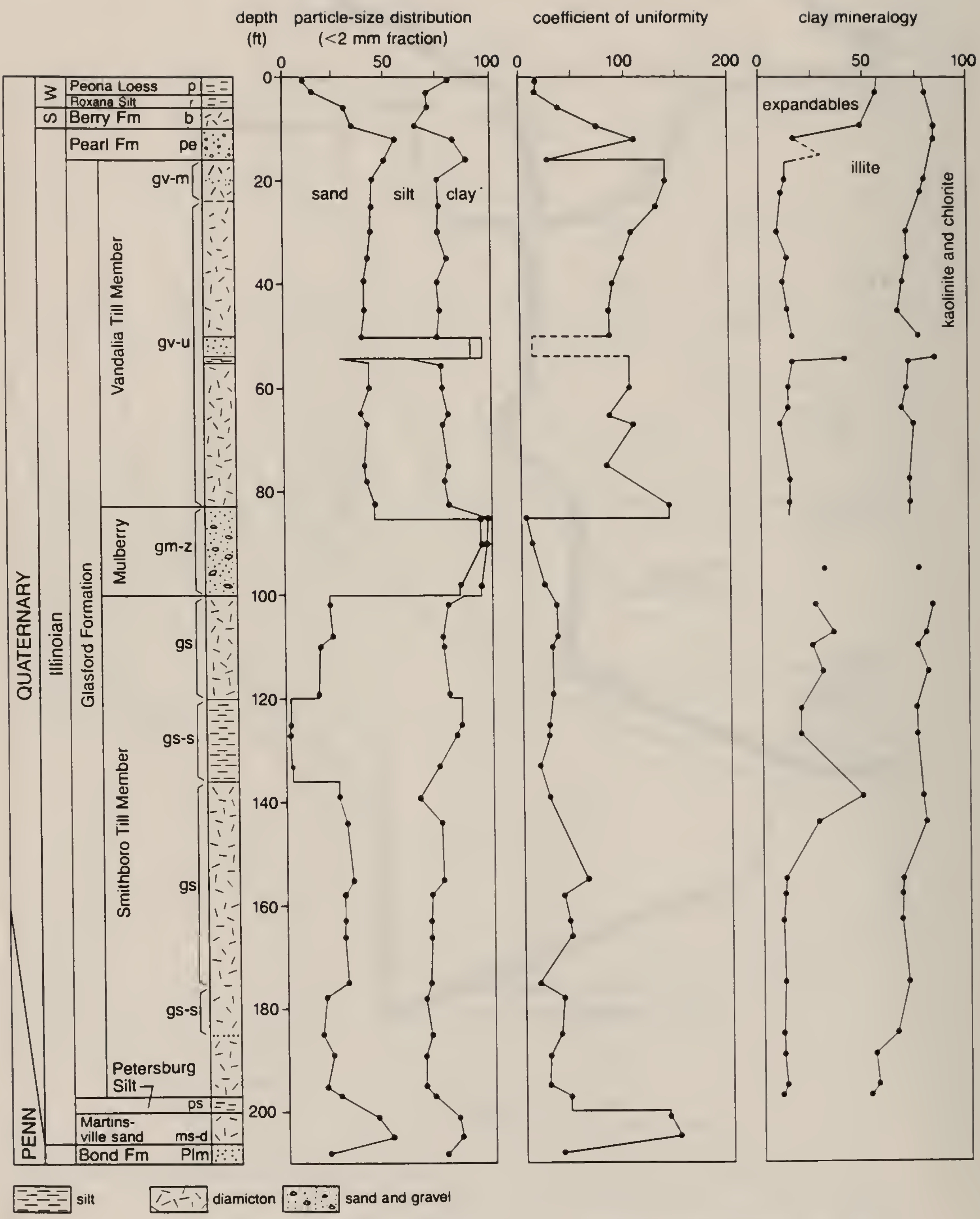


Figure 15 Lithofacies log and laboratory data from subsamples of core from M-106.

17.3 percent for the silt loam diamicton facies and 12.9 percent for the loam diamicton facies (table 1). The coefficient of uniformity is generally less than 50 for Smithboro diamictons, and greater than 50 for the overlying uniform diamicton facies of the Vandalia Till Member, described below. This factor indicates that the Vandalia is more poorly sorted than the Smithboro (table 1).

Kettles (1980) described the Smithboro and Fort Russell units within the Glasford Formation in the region. These units have similar lithic properties to those of the silt loam diamicton and loam diamicton facies, described above for the Smithboro (table 3). The gradational physical properties and contacts between the facies, and the repetition of facies at some borings (M-03 and M-07, for example) indicate the facies are likely part of one depositional unit. We, therefore, do not recognize the Fort Russell till member at the MAS. Another possibility is that Kettle's Fort Russell unit correlates with the lower part of the uniform diamicton facies of the Vandalia Till Member, described below.

Data in table 3 indicate that the silt loam diamicton facies of the Smithboro at the MAS contains about ten percent less expandable clay minerals and about seven percent more silt than the Smithboro as described in other studies. These differences may reflect a larger component of Petersburg Silt reworked within the Smithboro at the MAS.

Mulberry Grove Member The Mulberry Grove Member was described by Jacobs and Lineback (1969) and formalized as the Mulberry Grove Silt Member of the Glasford Formation by Willman and Frye (1970). Mulberry Grove at the MAS comprises three easily distinguishable facies composed of sand and gravel, diamicton, and silt. Because the sand and gravel facies is dominant at the MAS, silt is dropped from the name in this report. Regional distribution of the Mulberry Grove Member is not well known; sediments equivalent to the sand and gravel facies and the silt facies were described in the type area near Vandalia, Illinois (Jacobs and Lineback, 1969) and in Coles County (Johnson et al., 1972; Ford, open file). In outcrops elsewhere in Clark County, the Mulberry Grove was not found. The Mulberry Grove Member, as much as 31 feet thick under the MAS, is thicker adjacent to the MAS in the North Fork Embarras River valley at borings M-110 (32 ft) and M-111 (36 ft; fig. 17). In general, the Mulberry Grove Member corresponds to the Sand Facies described by Battelle Memorial Institute and Hanson Engineers (1990a, b, c; table 2 in this report).

Sand and gravel facies The sand and gravel facies (gm-z in table 1 and appendix) is composed of well-sorted, medium- to coarse-grained sand, and less poorly sorted sand and gravel, and sandy loam. Core recovery in this unit is poor, and samples are commonly disaggregated; undisturbed core is generally massive. The facies, as much as 27 feet thick under the eastern half of the North Fork Embarras River valley, is interbedded with thin layers of the diamicton facies. The sand and gravel facies also is thick in the northeastern part of the MAS, with a cumulative thickness of 20 feet at M-07 (figs. 15 and 18).

Diamicton facies The diamicton facies (gm-d) is composed of beds of gray loam to clay-loam diamicton less than 10 feet thick. The diamicton facies generally is interbedded with the sand and gravel facies, or in contact with the Smithboro Till Member, as in boring M-01 (fig. 18). The mineralogy and texture of the diamicton facies generally is similar to that of the Vandalia Till Member.

Silt facies The silt facies of the Mulberry Grove Member (gm-s) consists of silt and silt loam that is gray, yellowish brown to black, locally organic rich, and leached or weakly calcareous; the mineralogy is nearly identical to that of the underlying Smithboro Till Member (fig. 16). Less common than the organic rich silts are thin beds of gray, uniform calcareous silt associated with the diamicton facies; the mineralogy of these beds is nearly identical to the mineralogy of diamicton facies and the overlying Vandalia Till Member. The thickness of the facies generally is less than 1 foot at the MAS, but locally is as much as 10 feet (boring M-07). The silt facies at M-07 is composed of leached or calcareous organic-bearing silt with locally abundant root traces (fig. 16). This weakly developed soil correlates with Pike Soil (Willman and Frye, 1970), a pedostrati-

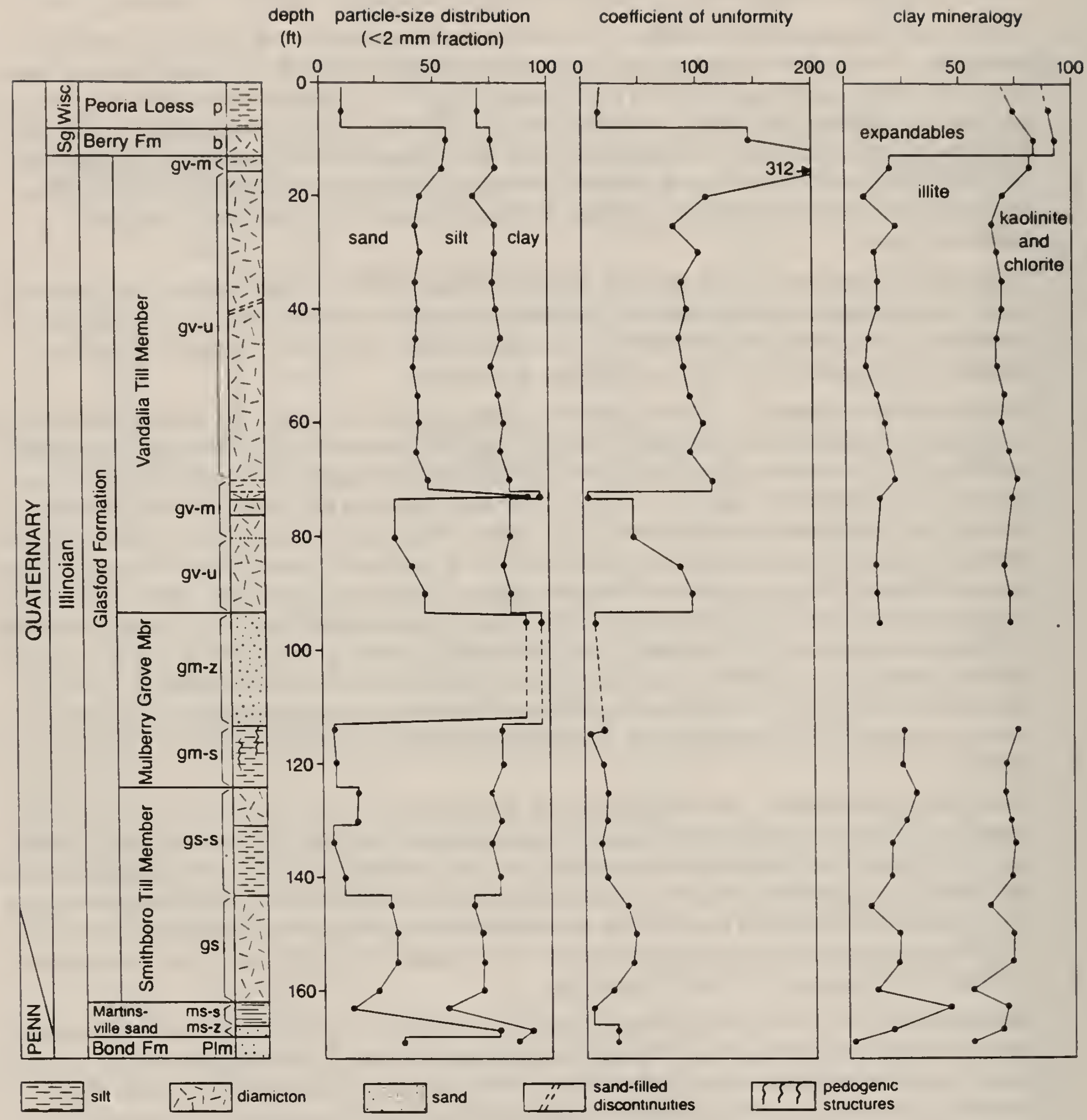


Figure 16 Lithofacies log and laboratory data from subsamples of core from M-07.

graphic unit, which has been described at several localities in central Illinois (Johnson et al., 1972; Fox, 1987).

Vandalia Till Member The Vandalia Till Member of the Glasford Formation, the thickest and most widespread till in central Illinois, has been mapped and described in several reports (Johnson, 1964; Jacobs and Lineback, 1969, Johnson et al., 1972; McKay, 1979; Lineback, 1979a,b; Follmer et al., 1979; Kettles, 1980; Hartline, 1981; Follmer, 1983; Fox, 1987). The Vandalia Till Member consists of loam diamicton that regionally has a distinct particle-size distribution and mineralogy (table 3). Mineralogy of the fine sand fraction indicates that the Vandalia was deposited by the Lake Michigan Lobe of the Laurentide Ice Sheet (Johnson, 1964; Fox, 1987).

Table 3 Comparison of textural and clay mineral attributes of three members of the Glasford Formation in central Illinois.

Unit Author (year of study) (No. of samples)	Percent of the <2μm fraction			Semiquantitative clay mineral analyses		
	Sand	Silt	Clay	Exp[1]	Illite	K/C[2]
Vandalia						
Kettles (1980) (199)[3]	46	33	21	12	66	22
Hartline (1981) (39)	45	35	20	16	65	19
Jacobs and Lineback (1969) (10)	43	38	19	9	70	21
Lineback (1981) (97)	42	35	23	9	70	21
This study: melange facies (86)	45	33	22	12	60	28
uniform facies (488)	43	35	22	12	58	30
Fort Russell						
Kettles (1980) (75)	35	41	24	23	57	20
Hartline (1981) (18)	40	38	22	24	56	20
Lineback (1981) (75)	32	42	26	24	54	22
Smithboro						
This study: Smithboro, loam diamicton facies (109)	32	45	23	26	47	27
Kettles (1980) (24)	26	50	24	40	41	19
Hartline (1981) (21)	23	49	28	45	37	18
Lineback (1981) (71)	25	47	28	43	38	19
This study: Smithboro, silt diamicton facies (218)	18	57	25	30	42	27
Smithboro, composite (loam diamicton and silt diamicton combined) (327)	23	53	24	29	44	27

[1] Exp = expandable clay minerals; [2] K/C = kaolinite and chlorite; [3] composite of Kettle's Till 50W and Till 50E

The mean coefficient of uniformity of particle-size distribution for Vandalia Till at the MAS is much greater than that of the underlying Smithboro (104 vs. 31, all facies combined; table 1), indicating that the Vandalia is more poorly sorted. The lower 10 to 15 feet of Vandalia Till, however, commonly is similar to the loam diamicton facies of the Smithboro Till Member in texture, sorting coefficients, and mineralogy. Where the Mulberry Grove is absent, the following characteristics aid in differentiating Vandalia and Smithboro diamictons in the contact zone:

a) basal Vandalia and the diamicton facies of the Mulberry Grove typically contain more illite than the loam diamicton facies of the Smithboro (mean values of about 60 percent and 47 percent, respectively);

b) basal Vandalia diamicton and the diamicton facies of the Mulberry Grove commonly have vermiculite indices less than zero; the loam diamicton facies of the Smithboro has values greater than 15;

c) the Vandalia rarely has X-ray diffraction peaks discernible from background at the 5.1° 2θ (17Å) position, which results in no measurement of the heterogeneous swelling index (HSI; ISGS, 1989). The opposite generally is the case with the Smithboro, and the HSI is greater than or equal to zero;

d) the Vandalia generally has coefficients of uniformity greater than 50; Smithboro has coefficients less than 50.

e) the silt loam diamicton facies of the Smithboro is readily distinguished from all other diamicton units at the MAS by its great silt content, abundant inclusions of wood fragments, silt stringers, gleyed sandstone, paucity of gravel to cobble-sized clasts, and platy structure.

Two facies of the Vandalia Till Member are recognized at the MAS: a lower, uniform diamicton facies, and an upper, mélange facies that is commonly oxidized and pedogenically modified in the upper 2 to 15 feet. In Battelle Memorial Institute and Hanson Engineers (1990a, b, c), the uniform diamicton facies is named the Vandalia Till, and mélange facies is named the Fractured Vandalia Till (table 2). In a few locations, the mélange facies occurs at or near the base of the uniform diamicton facies (fig. 16, for example). In such cases, the mélange facies is correlative with the Vandalia Till of Battelle.

Uniform diamicton facies The uniform diamicton facies (gv-u in table 1 and appendix) is as much as 129.4 feet thick at boring M-112 and locally is absent at the mouth of Bluegrass Creek adjacent to the MAS (fig. 19). Generally less than about 15 feet thick beneath the valley of North Fork Embarrass River, the uniform diamicton facies elsewhere in the study area is commonly at least about 40 feet thick. The uniform diamicton facies, composed of loam diamicton, is characteristically massive between discontinuities spaced more than 3 feet apart (Battelle Memorial Institute and Hanson Engineers, 1990a). When partly dried the core breaks with difficulty along near-horizontal partings that commonly have a discontinuous filling composed of sand or silt about one grain thick. These partings may be attributed to shearing of sorted sediment during deposition of lodgement till (Eyles, 1983). The uniform diamicton facies was not observed in outcrops in the study area.

Sand and gravel layers, locally as much as 18.5 feet thick at M-10, are present in the uniform diamicton facies at the MAS. Limited information from borings suggests that the sand and gravel occur in channels, but the width and length are unknown. A sand and gravel deposit that appears to have limited lateral continuity within the uniform diamicton facies at the MAS is referred to as Vandalia Sand by Battelle Memorial Institute and Hanson Engineers (1990a; table 2 in this report).

Mélange facies The mélange facies is composed of predominantly loam diamicton, with numerous layers, lenses, and pods of sand and gravel, and less commonly, well-sorted, uniform silt. Contacts between sand and gravel bodies, diamicton, and silt are sharp. Thickness of less than 3 feet of uniform diamicton in the mélange facies differentiates the unit from the uniform diamicton facies. The mélange facies is more than 23 feet thick in outcrop (CC-16) adjacent to the MAS, and as much as 30 feet thick under the MAS at boring M-104 (fig. 20). The distribution of the mélange facies is chiefly below the uplands. The facies generally is not present beneath the valleys of the North Fork Embarras River, and infrequently occurs ar depth within the uniform diamicton facies (for example, M-07; see fig. 16).

The mélange facies contains numerous discontinuities with variable orientation and habit. In outcrop, nearly vertical discontinuities are at least 10 feet long and filled with sand, at least 1.0 inch thick, and taper downward to a crack with no filling. The surfaces of the discontinuities vary from planar to wavy. Outcrops and unoriented core from angled borings indicate that the discontinuities occur in all orientations.

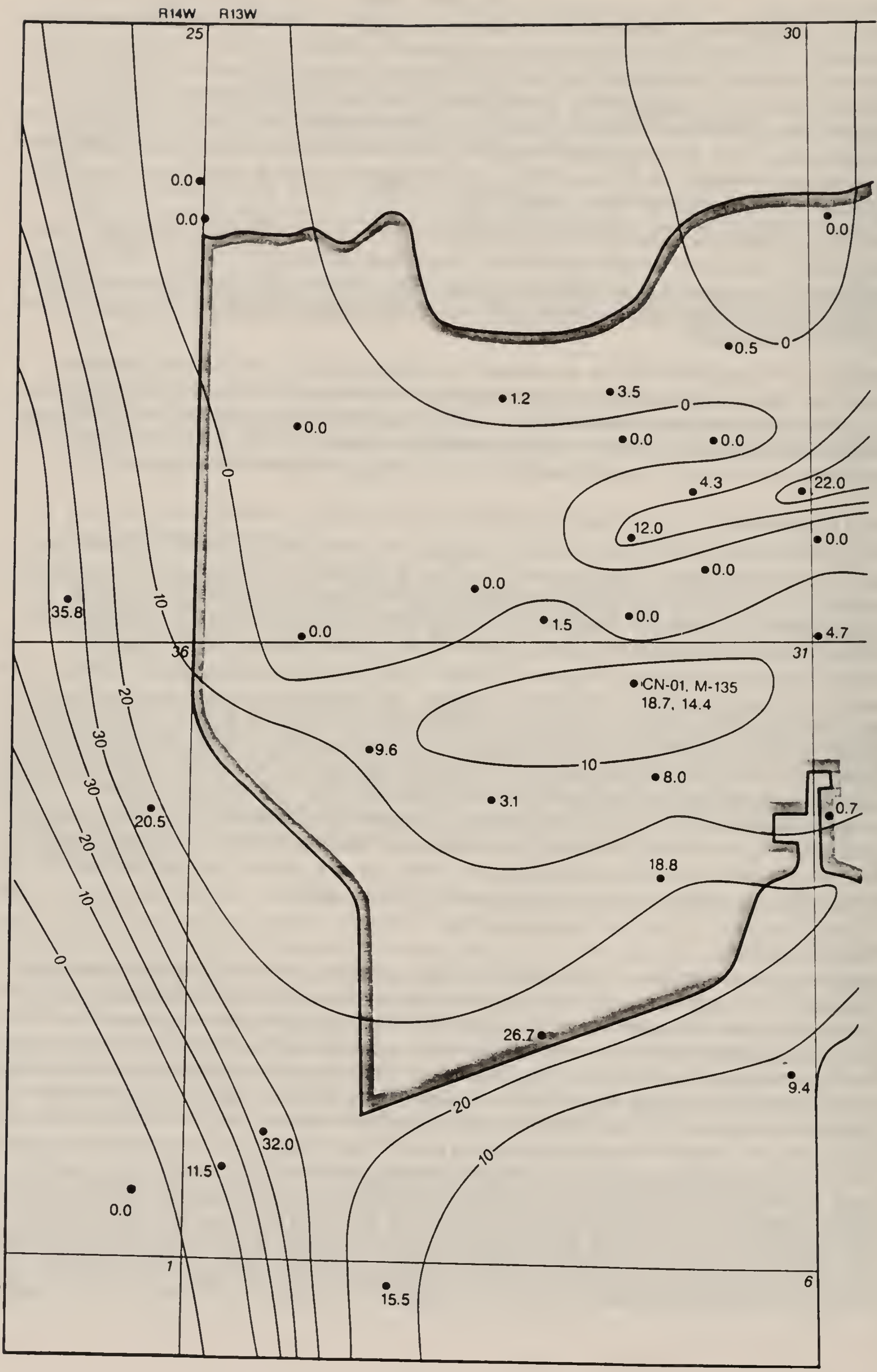
Diamicton of the mélange facies is somewhat more poorly sorted than the uniform diamicton facies (as indicated by the greater mean coefficient of uniformity of 112 vs 102), and contains relatively more illite, calcite, and dolomite (table 1). Mineralogical differences within the Vandalia elsewhere in Illinois also were noted by Hartline (1981), but in contrast to that study, the particle-size distribution of the <2 mm fraction is nearly identical for both facies at the MAS (table 1).

Pearl Formation

Pearl Formation discontinuously overlies the mélange facies of the Vandalia and underlies the Berry Formation beneath upland surfaces. The Pearl is not present in the alluvium in present-day valleys. The unit is called Upper Sand by Battelle Memorial Institute and Hanson Engineers (1990a; table 2 in this report). The mean thickness of the Pearl at the MAS is 1.9 feet; however, maximum thickness is about 13 feet in boring M-106W adjacent to boring M-106 (Battelle Memorial Institute and Hanson Engineers, 1990a). Pearl Formation is composed of stratified, very poorly sorted sand and gravel, thin beds of silty clay, and uniform, well-sorted medium-grained sand. Illuvial clay occurs in the upper portion of the Pearl and is related to the Sangamon Soil. The pedogenic origin is indicated by an abundance of fine clay (<1 μm) relative to coarser clay (1-4 μm; fig. 21). Pearl Formation particles commonly are stained and coated with sesquioxides and clay that demarcate gamma horizons (layers of translocated clay, organic matter, and sesquioxides below a primary and beta B horizons; Johnson and Hansel, 1989). Pearl Formation mineralogy is similar to that of the uppermost weathered Vandalia diamicton. The lower contact of the Pearl at outcrop CC-16 is convoluted, above which are stratified and undeformed beds of sand or silty clay, completely stained black and red by sesquioxides.

Berry Formation

Berry Formation, as much as 13 feet thick, is composed of leached and pedogenically modified loam to clay loam diamicton. Berry Formation mantles weathered Glasford till members and underlies Wisconsinan loesses across most of the Illinoian till plain (Willman and Frye, 1970). Beneath the upland surfaces at the MAS, Berry Formation is a continuous layer that overlies the Pearl Formation and the Vandalia Till Member of the Glasford Formation, and underlies the sandy silt facies of the Roxana Silt. Berry Fromation is not present in the alluvium of present-day valleys. Previously called the Berry Clay Member of the Glasford Formation (Willman and Frye, 1970), this unit has been elevated in this report to formational status because it overlies the Pearl Formation and possesses unique and uniform lithologic characteristics (b in figs. 11, 12, and 13; table 1). Willman and Frye (1970) thought this unit was part of the Glasford Formation because they interpreted it as primarily colluviated Glasford tills. Evidence of colluviation of Pearl Formation is observed at CC-16 where beds of stratified sand and gravel are truncated by leached loam diamicton. In most cases at the MAS, however, Berry Formation is interpreted as the Btg horizon of the Sangamon Soil developed in Pearl Formation or the Vandalia Till Member. In other studies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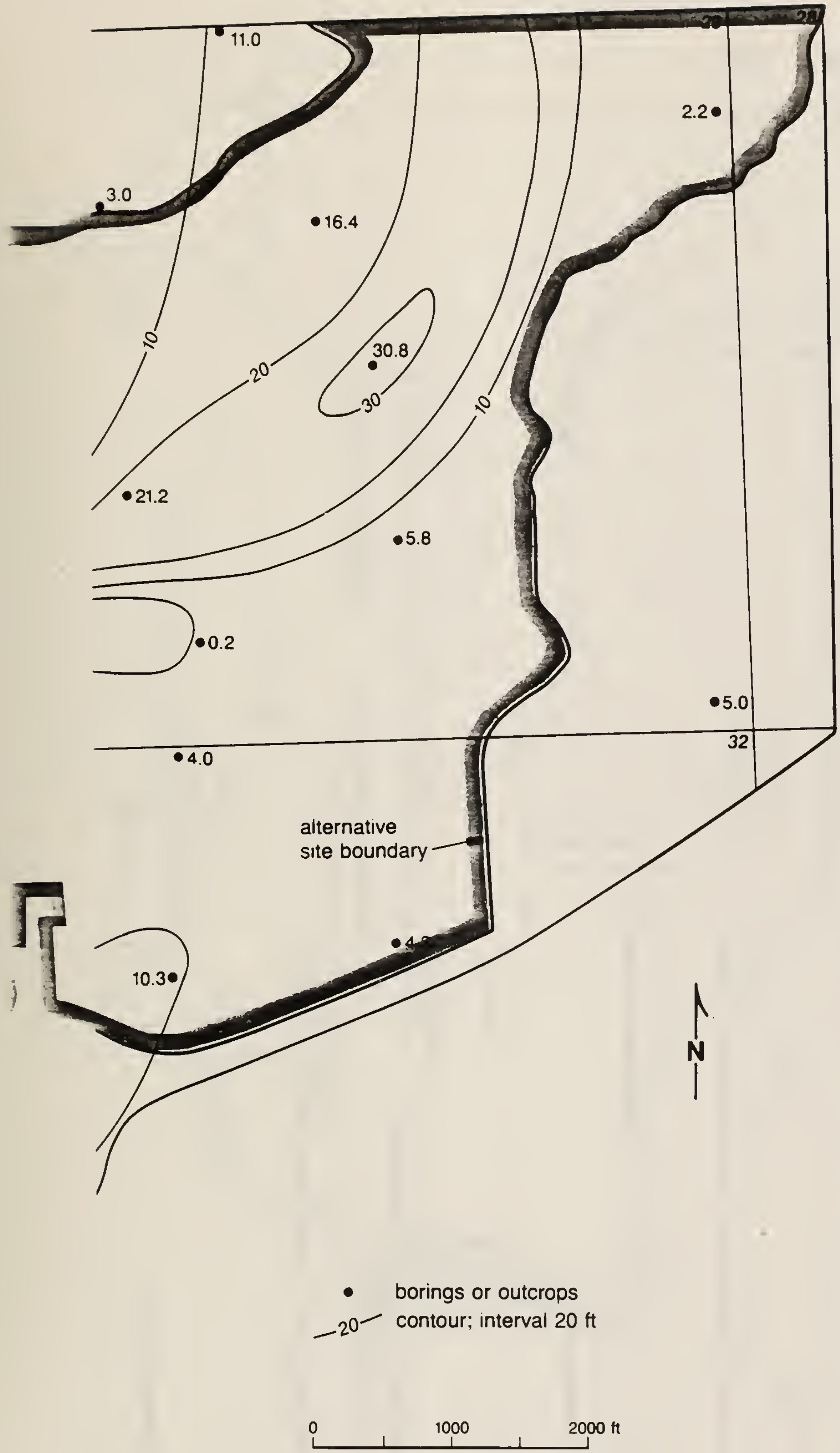
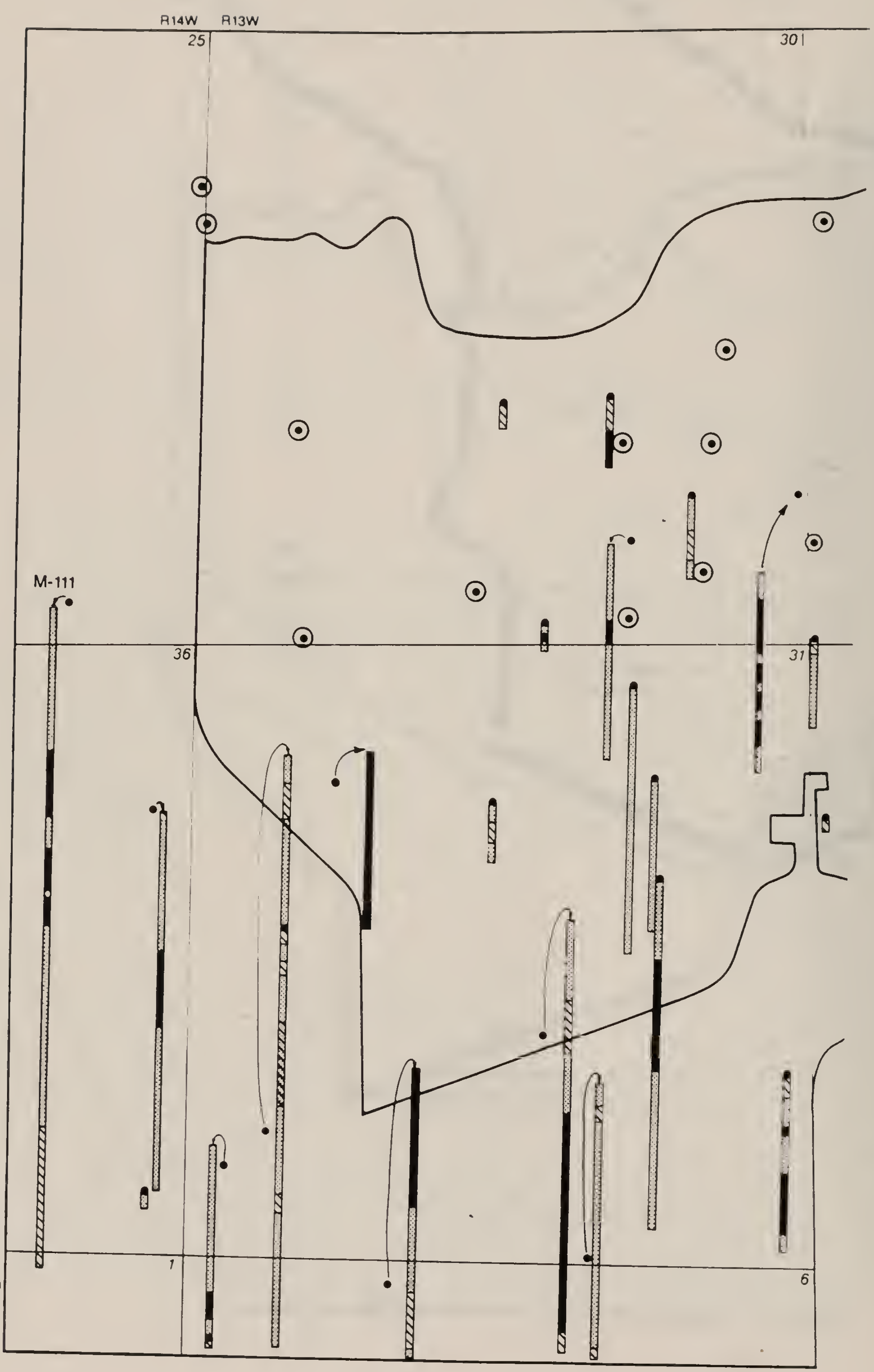


Figure 17 Thickness of the Mulberry Grove Member, Glasford Formation.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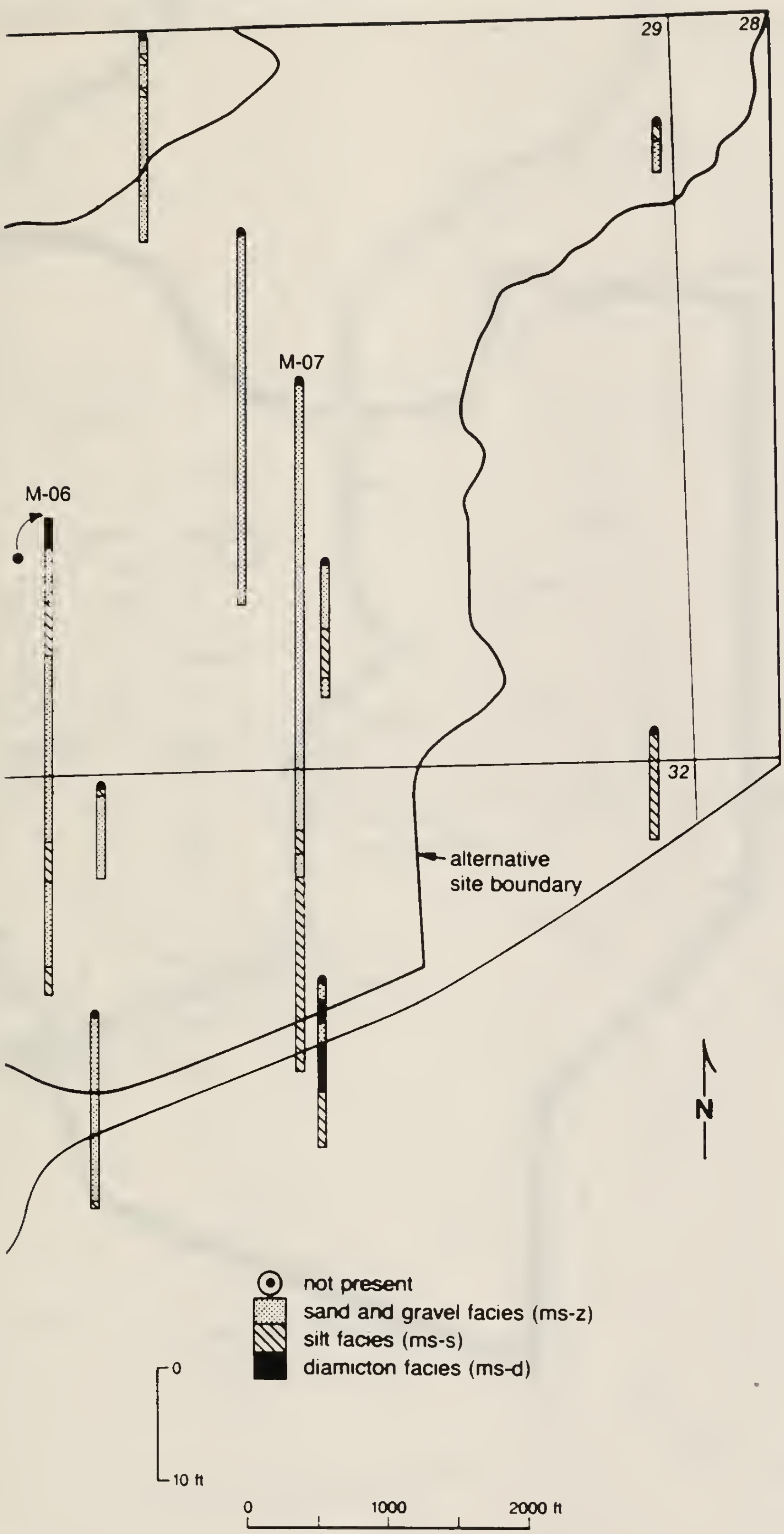
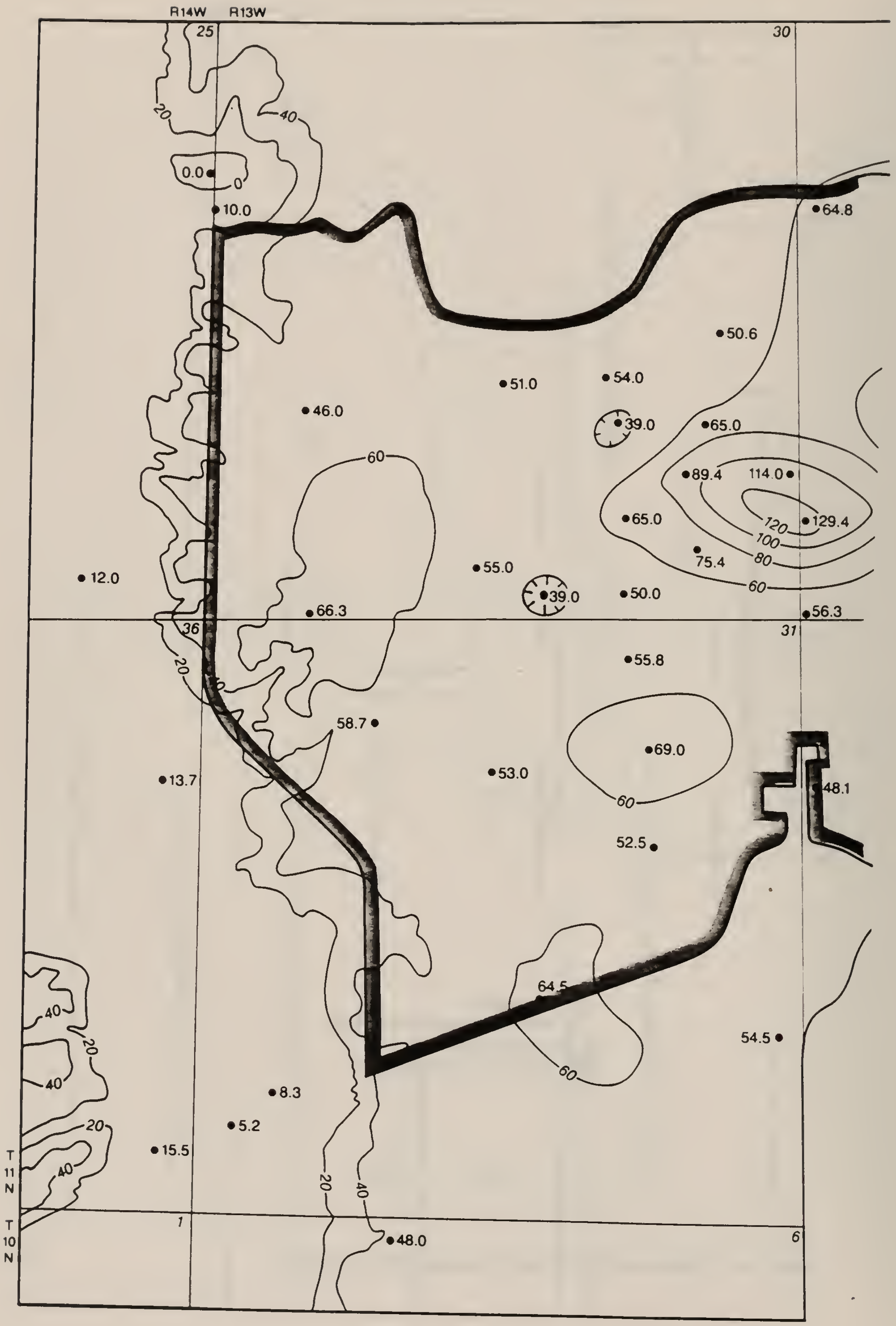


Figure 18 Thickness and lithofacies of the Mulberry Grove Member.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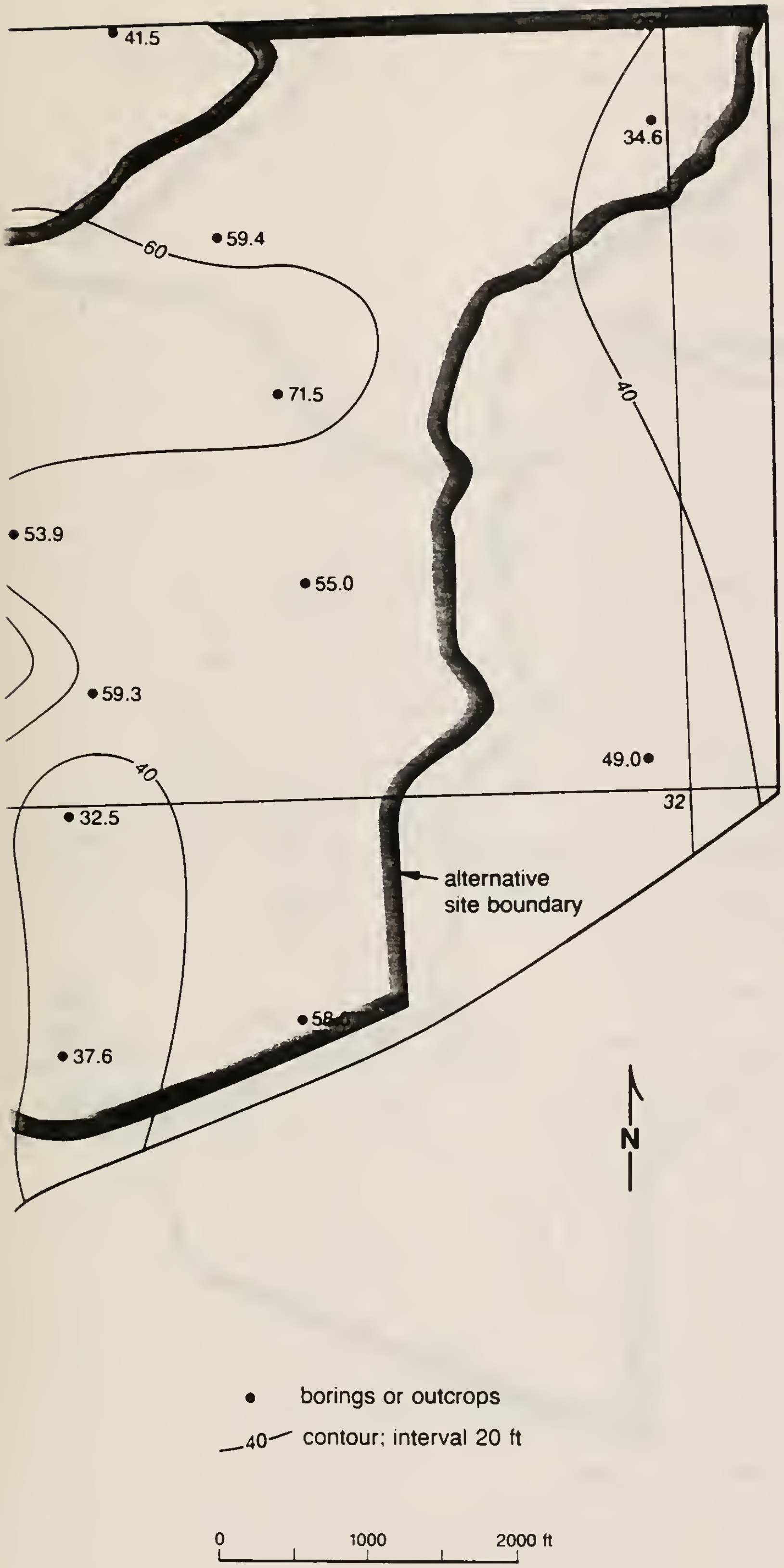
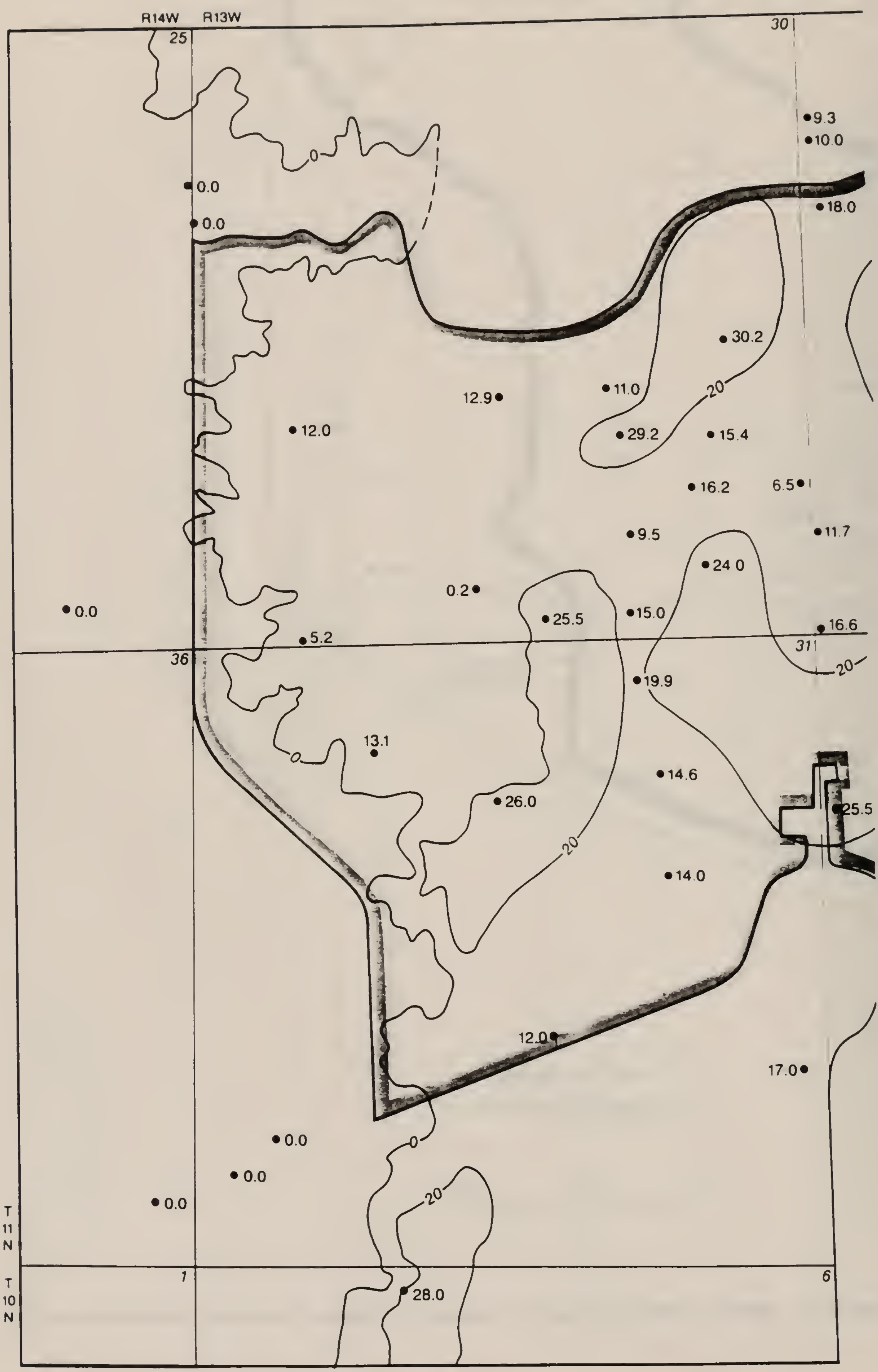


Figure 19 Thickness of the uniform diamicton facies of the Vandalia Till Member, Glasford Formation.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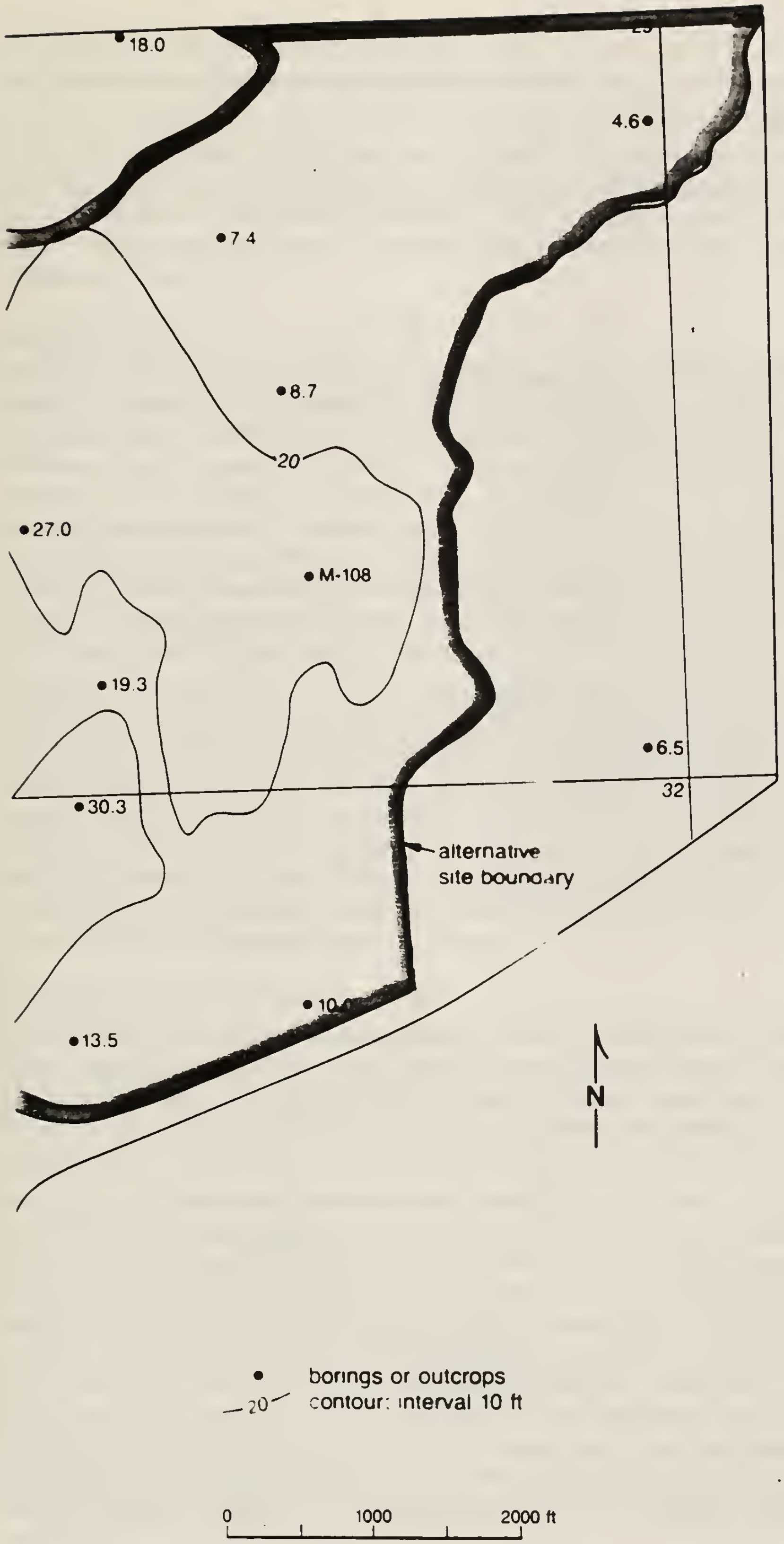


Figure 20 Thickness of mélange facies of the Vandalia Till Member, Glasford Formation.

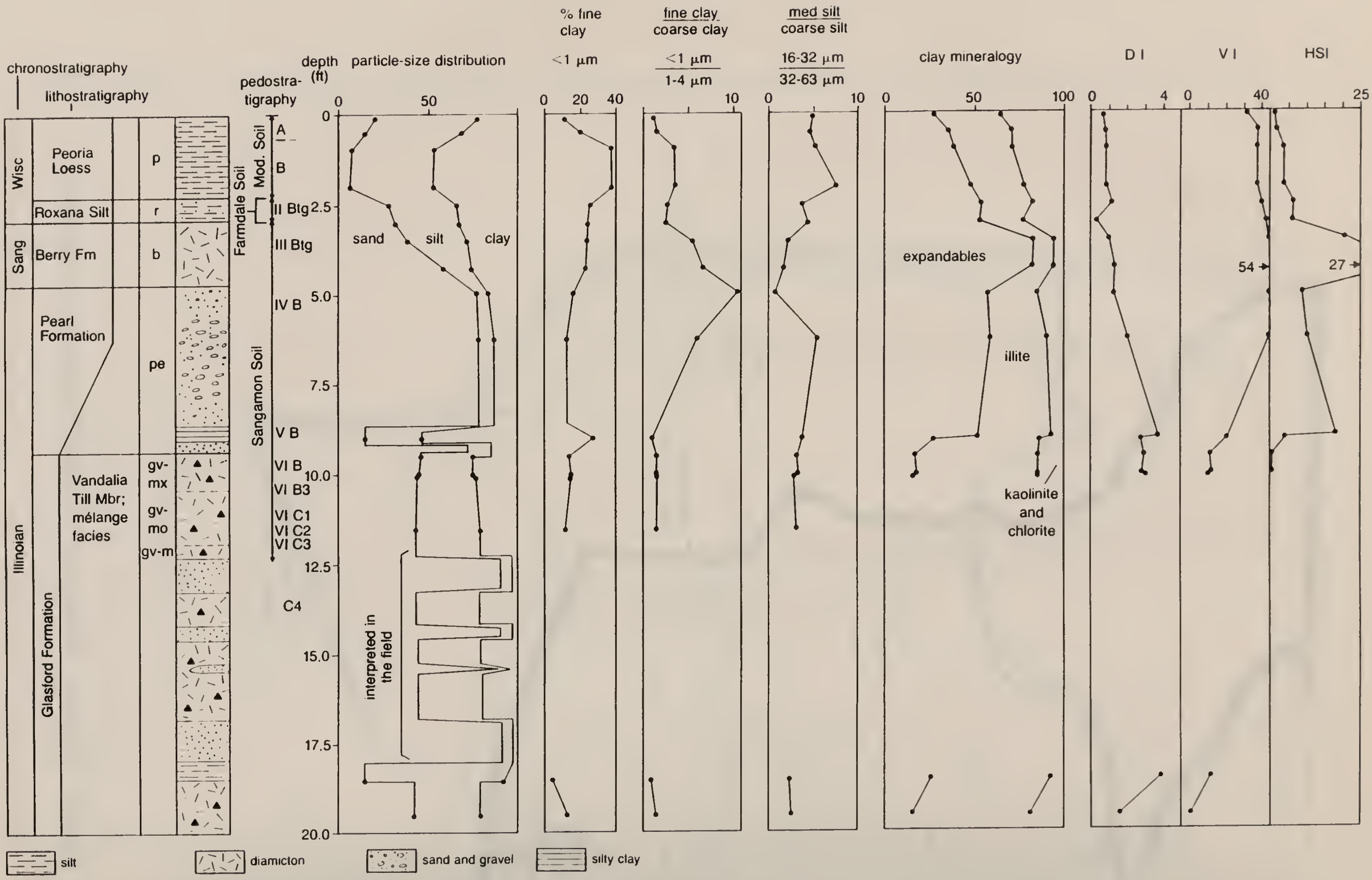


Figure 21 Lithofacies log and laboratory data from subsamples of outcrop CC-16. Triangles denote the relative abundance of >2 mm fragments per unit.

(e.g., Follmer, 1982) that emphasize genesis and not common lithic characteristics, these deposits would be considered altered parent material (i.e., Pearl Formation) and not Berry Clay.

The Berry Formation contains more expandable clay minerals than underlying units (fig. 21), although the lowermost portion often has a clay mineral composition similar to that of oxidized Vandalia diamicton. The contact between the Berry and Vandalia generally is sharp. The overlying Roxana Silt can be distinguished from Berry Clay because Roxana possesses smaller pedogenic features and little or no gravel. The contact between the Berry and Roxana generally is gradational across a 1 foot zone.

Sangamon Soil

Pedogenic alteration of the upper part of the mélange facies of the Vandalia Till Member of the Glasford Formation, Berry Formation, and Pearl Formation is attributed to development of the Sangamon Soil. The B horizon of the Sangamon Soil commonly occurs in Berry Formation, Pearl Formation and the upper 1 to 2 feet of the mélange facies of the Vandalia Till Member. The latter material (gv-mx in table 1) is dominated by 1) pedogenic structures, such as blocky to granular peds with continuous clay skins (argillans), 2) reddish, brownish or greenish hue, and 3) abundant, variably swelling vermiculite and smectite (fig. 21; Curry, 1989). Generally firm or hard, the B horizon has an abrupt, upper contact with sand and gravel (Pearl Formation) or soft, clayey diamicton (Berry Formation). Willman et al. (1963) and Follmer (1983) interpreted Berry Clay to be the very poorly drained, colluvial pedofacies of the Sangamon Soil.

At greater depth in the C horizon, oxidation occurs along discontinuities in diamicton as complete to incomplete coatings of sesquioxides, with oxidized sediment occurring between discontinuities below the B horizon. Stained discontinuity faces are infrequently observed 20 feet or more below oxidized diamicton matrix. In addition, staining commonly occurs in the upper parts of sand and gravel bodies often sandwiched between unaltered diamicton. Oxidation of the diamicton also is detected in the mineralogical analyses of the <2 μm fraction; the pedogenic transformation of chlorite to vermiculite results in lower chlorite and kaolinite values (mean values for gv-mo and gv-m are 15.7 and 28.0, respectively) and greater vermiculite indices (mean values for gv-mo and gv-m are 12.0 and 4.9, respectively).

Sandy Silt Facies of the Roxana Silt

The sandy silt facies of the Roxana Silt was named by Johnson et al. (1972) to designate a zone composed of pedogenically mixed Sangamonian sediment and Wisconsinan loess (Roxana Silt). The sandy silt facies of Roxana Silt near Casey, Illinois, is described in detail by Follmer (1982). At the MAS, the Roxana is composed of pedogenically modified, leached loam containing abundant nodules and ped coatings composed of organo-sesquioxides.

Roxana Silt is differentiated from the Berry Formation and Peoria Loess on the basis of particle-size distribution and stratigraphic position. The Roxana Silt at the MAS may be sandier than at other parts of Illinois (i.e., Follmer, 1982; Johnson et al., 1972) because of a potential proximal source of eolian sediment derived from the valley of the North Fork Embarras River. In general, the Roxana differs from the underlying Berry Formation by its content of more than about 35 percent silt and less than 2 percent gravel. Roxana Silt generally can be distinguished from the overlying Peoria Loess by its content of more than 15 percent sand; the Peoria also contains little or no gravel. Clay mineralogy is not a useful differentiating criterion because Berry Formation, Roxana Silt and Peoria Loess at the MAS contain abundant expandable clay minerals (62, 68, and 53 percent, respectively; table 1). The mean thickness of the sandy silt facies of the Roxana Silt in the region is about 15 inches (Fehrenbacher et al., 1986); at the MAS, the mean is about 36 inches.

Farmdale Soil

The Farmdale Soil is developed in the top of the Roxana Silt, and possesses cumulic B, E, or A horizons above the Sangamon Soil. Pedogenic characteristics of the Farmdale are very similar to,

but not as prominent as those of the Sangamon Soil. Typically, angular blocky structure is somewhat coarser, and sesquioxide concretions are finer in the Farmdale than in the Sangamon. The Farmdale also is typically grayer than the Sangamon. Contact with the overlying modern soil generally is sharp, and recognized on the basis of lithologic differences between the Roxana Silt and Peoria Loess. The Bt horizon of the modern soil generally is above the Farmdale Soil in Peoria Loess.

Wedron Formation, Fairgrange Till Member

The Fairgrange Till Member of the Wedron Formation, although absent at the MAS, is present 8 miles northwest of the study area below the Shelbyville Moraine. The moraine marks the maximum southward advance of the late Wisconsinan Lake Michigan Lobe about 20,000 years ago (fig. 1). The Fairgrange Till Member is composed of chiefly clay loam diamicton and subordinate sand and gravel (Ford, 1970).

Peoria Loess

Peoria Loess, named by Frye and Leonard (1951), is further discussed in McKay (1979). Its local character is described in Follmer (1982). As it does regionally, Peoria Loess continuously mantles the upland surface. Peoria Loess at the MAS generally is less than 6 feet thick and composed of leached, pedogenically modified silt loam, silty clay loam, and silty clay. A sand content of less than 15 percent distinguishes it from the underlying Roxana Silt. The mean texture of the Peoria is about 5 percent sandier than the regional mean (Fehrenbacher et al., 1986), which may be explained by an admixture of silty loess and eolian sand derived from the valley of the North Fork Embarras River. The modern soil is developed in Peoria Loess, which imparts pedogenic features such as biopores (roots, etc.), clay cutans, and structure (peds). At outcrop CC-16 (fig. 21) the B horizon of the modern soil occurs in the lower Peoria. This conclusion was based on an increase in fine clay ($<1 \mu m$) and total clay in this zone, as well as medium subangular blocky structure with continuous clay skins.

Parkland Sand

Parkland Sand, named and described by Willman and Frye (1970), consists of predominantly very-fine to fine-grained sand (Table 1). The Parkland Sand is as much as 5 feet thick at M-01, and only locally present on upland surfaces in a corridor about 0.5 mile wide east of the North Fork Embarras River valley. Parkland Sand, probably eolian in origin, is mapped on upland surfaces outside the MAS east of the North Fork Embarras River (Lineback, 1979a).

Henry Formation

The Henry Formation in central Illinois was named and described by Willman and Frye (1970). It consists of surficial sand and gravel from late Wisconsinan glaciation, and thus would be restricted to the North Fork Embarras River valley adjacent to the MAS. Beyond the late Wisconsinan glacial margin, thick Henry Formation occurs in the valleys of large streams and rivers commonly forming terraces adjacent to the Holocene floodplain (e.g., Miller, 1973; Hajic, 1990). In the valley of the North Fork Embarras River, a stratigraphic unit such as Berry Formation would permit differentiation of Wisconsinan from Illinoian sand and gravel, but such a unit has yet to be described in the fluvial sediments. Therefore, Henry Formation is not recognized on or adjacent to the MAS, although it has been mapped about 7 miles to the north along the headwaters of the North Fork Embarras River (Lineback, 1979a).

Cahokia Alluvium

Cahokia Alluvium was named and described by Willman and Frye (1970) from deposits in the Mississippi River valley near East St. Louis, Illinois. The character of the Cahokia has been studied in the lower Illinois River valley (Hajic, 1985; 1990), and along tributaries to the Vermilion River near Danville, Illinois (Stanke, 1988). In the study area, Cahokia Alluvium occurs below wide terraces

along valleys from 1 to 7 feet above the modem river and stream beds, and in the channels of modem rivers and streams. Cahokia at the MAS probably is no more than about 12 feet thick along tributary valleys of the North Fork Embarras River, Bluegrass Creek, and Kettering Branch. Adjacent to the MAS in the North Fork Embarras River Valley, the Cahokia is as much as 35 feet thick. Pre-Holocene pedostratigraphic and lithostratigraphic units have not been encountered in the alluvial sequences at or adjacent to the MAS, and the age of the Cahokia may be from late Illinoian to Holocene.

Cahokia Alluvium at and adjacent to the MAS consists of well-sorted, medium- to coarse-grained sand, gravel, silt loam, and loam. The alluvial sequences comprising the wide terraces along the valley bottoms are composed of poorly sorted gravel, pebbles, and cobbles, and overlain by gleyed, well-sorted, medium-grained sand and pedogenically altered loam and silt loam. Well-sorted, medium-grained sand comprises the bed load of present-day streams at low flow, and also forms a thin mantle above the terrace sediments adjacent to the modern stream channels. The mantle was deposited during recent floods. Numerous bars along the stream channels are composed of well-sorted sand or coarser rock fragments, as much as 2.0 feet across.

Peyton Colluvium

Peyton Colluvium was named and described by Willman and Frye (1970) for deposits near Peoria, Illinois. Peyton Colluvium occurs as deposits primarily at the base of slopes between the uplands and valleys of the North Fork Embarras River, Bluegrass Creek, Kettering Branch, and their tributaries adjacent to and on the MAS. The lithology of Peyton Colluvium is presumably similar to the character of the sediment from which the colluvium is derived. The Peyton has been described in colluvial and alluvial fans along the lower Illinois River associated with archaeological sites (Hajic, 1985).

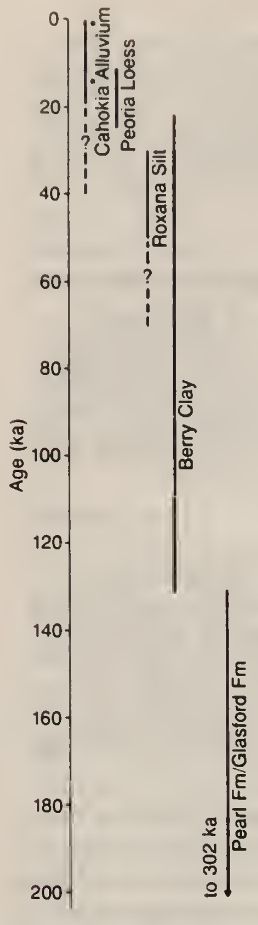
At the MAS, Peyton Colluvium is composed of loose, pedogenically altered loam diamicton. The thickness of Peyton Colluvium was not measured at the MAS. The unit is 4 feet thick at outcrop CC-19 adjacent to Bluegrass Creek (fig. 2, see appendix). The upper 1.4 feet is composed of yellowish brown loam diamicton that overlies 2.6 feet of reddish loam diamicton. The Peyton at CC-19 overlies brittle, oxidized, leached loam diamicton of the Vandalia Till Member, considered to be the lower part (C1 horizon) of the Sangamon Soil.

Lacon Formation

William and Frye (1970) named and described the the Lacon Formation. This surficial lithostratigraphic unit is composed of sediment flows and landslide material. Because of the genetic definition of the Lacon Formation, its regional composition varies. Adjacent to the MAS, small earth slumps were noted along Bluegrass Creek where the stream was impinging on the valley wall. The largest slump, noted in early spring 1989 at outcrop CC-16, was composed of reworked Vandalia Till and overlying upland units. The slump involved approximately 5,000 ft^3 of debris. Much of the slump material had been removed by the creek later in the spring.

GEOCHRONOLOGY

The chronologic age of lithostratigraphic units at the MAS is not well understood from on-site determinations. The age of some deposits are estimated by regional correlation of these units where the chronology is better known (fig. 22). The confidence in these numerical estimates lessens with older ages. Along the Illinois River valley, Peoria Loess was deposited from about 25,000 to 12,000 B.P. (McKay, 1979), and Roxana Silt, from about 30,000 to 50,000 B.P. (McKay, 1979; Curry and Follmer, in preparation). Three ages from the Berry Formation include 75,000 ±10,000 years, 41,770 ± 1100 yr B.P. (ISGS-684; Follmer, 1983), and 21,400 ±1000 yr B.P. (ISGS-46; Johnson et al., 1971). The older age was determined by electron spin resonance (ESR) techniques on a mastodon tooth (Blackwell et al. 1990), and the younger ages, by radiocarbon assay of organic-rich sediment. The two older ages are considered to be more representative of the regional age of Berry Formation rather than the 21,400 yr B.P. age. Richmond and Fullerton



Unit	Age (ka)	Reference	Basis of age/region or site
Peyton Colluvium	not determined	—	—
Cahokia Alluvium	14.5-0.3	this study	^{14}C ages on wood adjacent to MAS (0.3 and 14.5 ka)
Peoria Loess	25.0-12.5	McKay, 1979; Follmer et al, 1979	^{14}C ages on wood; lower Illinois River valley; Athens Quarry
Roxana Silt	50.0-30.0	McKay, 1979; Curry and Follmer, in press	^{14}C ages on organic-rich sediment, wood and snails; lower Illinois River Valley, Athens Quarry
Berry Clay	132-20	Johnson et al., 1971;	^{14}C age on organic-rich clay, Shelbyville (21 ka)
		Blackwell et al, 1990;	Electron-spin resonance age on mastodon molar, Hopwood Farm (70 ± 10 ka)
		Richmond and Fullerton, 1986	Orbitally-tuned marine records (132-70 ka)
Pearl Formation, Glasford Formation, Petersburg Silt	302-132	Richmond and Fullerton, 1986	Orbitally-tuned marine records
Banner Formation	788-302	Richmond and Fullerton, 1986	Orbitally-tuned marine record; Matuyama-Bruhnes magnetochron (≈ 788 ka)

Figure 22 Estimation of unit ages based on data from outside the MAS.

(1986) estimated the age of Illinoian deposits, extrapolated from orbitally-tuned oxygen isotope deep-sea records, to be from 130,000 to 300,000 yr B.P.

Correlation of the Petersburg Silt with other early Illinoian deposits is supported by amino acid racemization techniques. The amino acid racemization reaction used in this study is a measurement of the relative amount of alloisoleucine (alle) and isoleucine (Ile) (McCoy, 1987). The shells of living gastropods contain only isoleucine. Through geologic time, isoleucine epimerizes to its nonprotein diastereomer alloisoleucine, and the ratio, expressed as alle/Ile, increases to an equilibrium value of 1.30 ±0.05. Although the rate of this reaction is known, the temperature history of the sample must be known within 1 percent variance through time to calculate a numerical age with about 30 percent accuracy. The temperature history, however, generally cannot be assumed or measured with such precision (McCoy, 1987). Thus, determining meaningful numerical ages using this technique at the MAS was not attempted.

If deposits in a geographic area have experienced similar temperature histories, measurements of amino acid racemization can be used for relative age correlations. Typically, the data are presented as alle/Ile in the free and peptide-bound amino acids or total amino acid hydrolysate (e. g., Clark et al. 1989), or as alle/Ile in the total hydrolysate vs. alle/Ile in the free hydrolysate. Six amino acid racemization measurements were made of gastropods from core collected at the MAS and from outcrop CC-11, including Petersburg Silt, and the Smithboro Till Member and Mulberry Grove Member of the Glasford Formation (table 4). The results indicate these units correlate with Illinoian deposits near the type sections (fig. 23; Miller et al., 1988) and other sediments in western Indiana (Miller et al., 1987).

Table 4 Amino acid measurements of gastropod shells (from William McCoy, personal communication, 1989).

Core or boring (depth, ft)	Unit	Genus	Lab # AGL-	Analyses	Free hydrolysate	Total hydrolysate
M-07 (118.0)	Mulberry Grove, silt facies	*Succinea*	1324	4	0.35 ± 0.01	0.25 ± 0.01
M-14 (113.5)	Smithboro Till Member, silt loam diamicton facies (inclusion of Petersburg Silt)	*Stenotrema*	1325	2	0.27	0.15
M-14 (147.0)	Petersburg Silt	*Pomatiopsis*	1326	2	—	0.19
CC-11	Mulberry Grove, silt facies	*Hendersonia*	1327	3	0.30	0.17
CC-11	Mulberry Grove, silt facies	*Stenotrema*	1328	2	0.30	0.19
CC-11	Mulberry Grove, silt facies	*Anguispira*	1329	2	0.31	0.13

Three radiocarbon ages were determined from wood fragments in Cahokia Alluvium adjacent to the MAS. A coniferous wood fragment found in a buried, organic-rich horizon along Bluegrass Creek 500 feet downstream of CC-16 yielded an age of 23,720 ±300 yr B.P. (ISGS-2113), indicating that the oldest age of the Cahokia is at least middle Wisconsinan. Well-preserved, coniferous wood fragments (probably spruce) from a depth of 10.8 to 11.2 feet at boring M-120 (fig. 2) yielded an age of 14,490 ±140 yr B.P. (ISGS-2024). A carbonized wood fragment, probably hickory (Follmer, personal communication, 1990), from a depth of 4.5 feet at outcrop CC-18 (fig. 3) yielded an age of 320 ±70 yr B.P. (ISGS-2073), confirming the age of the Cahokia to be in part Holocene, as well as providing a minimum age for the broad terrace surface adjacent to the present-day streams of the Bluegrass Creek and the North Fork Embarras River. Corrections of the radiocarbon age as indicated by Stuiver and Pearson (1986) put the age in calendar years between 1474-1648 A.D. The age also indicates that potential archeological sites in the valley bottoms may be buried by a considerable thickness of alluvium.

QUATERNARY GEOLOGICAL HISTORY AND ENVIRONMENTS OF DEPOSITION

The glacial stratigraphy of the MAS appears representative of Illinoian deposits in Illinois. Pre-Illinoian till units are not present at the site, but are found adjacent to the site. The tremendous amount of data available for the MAS allows for detailed characterization of several units, including their thickness and distribution within two buried bedrock valleys. Interpretations of the environment of deposition of most units is limited to what can be inferred from examination of core and isopach maps.

Pre-Illinoian

The age of the inception of the regional buried bedrock valley system is uncertain, but is Pre-Illinoian or possibly early Pleistocene, as indicated by the age of bedrock valley alluvial fill and till units elsewhere in the state (Horberg, 1950; Willman and Frye, 1970). The earliest Quaternary glaciations in central Illinois are pre-Illinoian. Although till of this age is not at the MAS, the Casey till member of the Banner Formation is present about 10 miles north, east, and west of the MAS (MacClintock, 1929; Kettles, 1980; Fox, 1987; Ford, ISGS open-file report), and other Banner tills have been described near Danville, Illinois (Johnson, 1964; Johnson et al. 1972).

Pre-Illinoian sediments were weathered during the Yarmouthian Stage, during which Lierle Clay was deposited predominantly as colluvium, including at the MAS. The beginning, end, and duration of pre-Illinoian and Yarmouthian Ages are unknown.

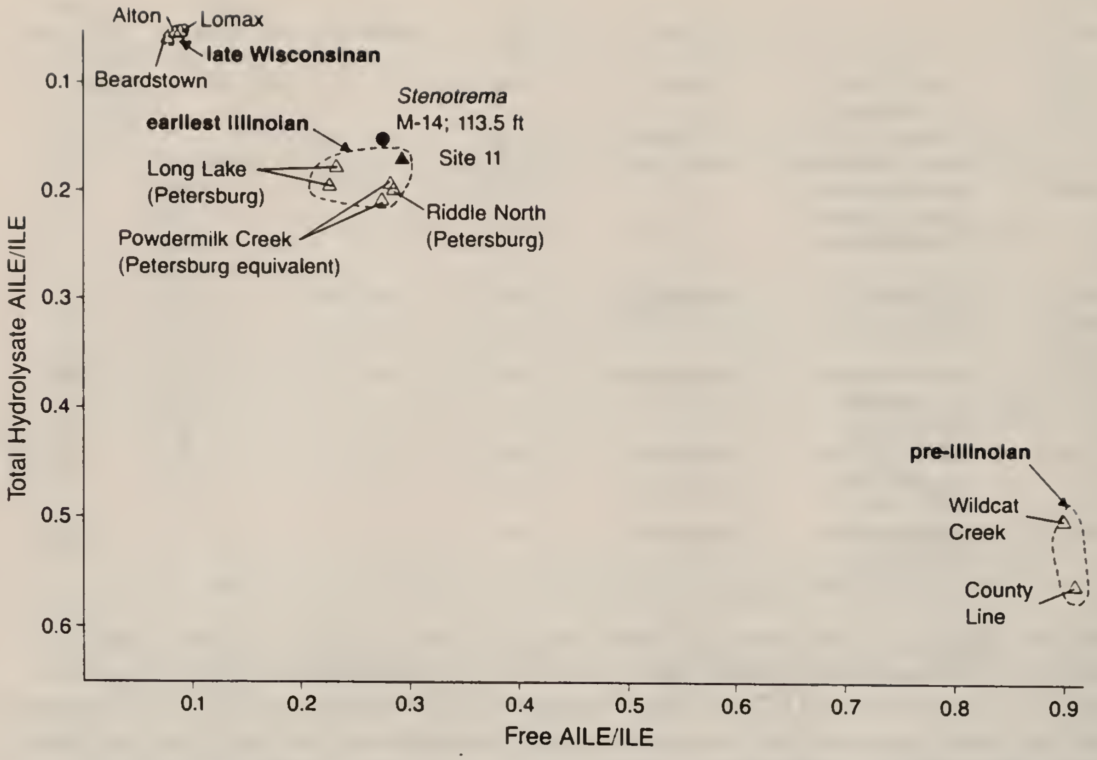


Figure 23 Plot of alle/Ile in the total hydrolysate vs. alle/Ile in the free hydrolysate of *Hendersonia* and one *Stenotrema* showing that samples from the study area (solid) correlate with Petersburg Silt near the type area (open). Earliest Illinoian data from Miller et al. (1988); other data from Clark et al. (1989)

Pre-Illinoian lacustrine sediments near Danville, Illinois, and in adjacent western Indiana have normal and reversed paleomagnetic polarity (Johnson, 1986). The last change from normal to reversed polarity is the Matuyuma-Brunhes magnetochron that occurred about 788,000 years ago (Richmond and Fullerton, 1986). If the Casey till member correlates with the Hillery Till Member of the Banner Formation in the Danville area as suggested by Kettles (1980), it is less than 788,000 years old.

Earliest Illinoian - Martinsville Sand and Petersburg Silt

The sequence of sediments at the base of the buried bedrock valleys appear to have been deposited during early Illinoian. Yarmouthian Lierle Clay is present along the flanks, but not along the bottoms, of the buried bedrock valleys beneath and adjacent to the MAS. No more than 25 feet of downcutting is inferred to have occurred during deposition of the supradjacent Martinsville sand when earliest Illinoian streams were at or near the base of the MAS and the North Fork buried bedrock valleys. These buried bedrock valleys are now filled with the thickest known occurrences of several Illinoian units: Petersburg Silt, and Smithboro Till, Mulberry Grove, and Vandalia Till Members of the Glasford Formation. The base of the sequence, informally named Martinsville sand, is composed of colluvium, alluvium, and lacustrine sediment. The Martinsville deposits contain clay minerals very similar in composition to the clay minerals in underlying bedrock. The Martinsville sand is believed to be early Illinoian because of the abundance of coniferous wood fragments and weakly expressed pedogenic characteristics such as gleyed colors and few root traces. Features or products characteristic of interglacial weathering, such as rounded subangular blocky soil structure, cutans, krotovina (crayfish burrows filled with black, clayey sediment; Follmer et al., 1979), and abundant clay particles <1 μm in diameter, are not evident in any facies of the Martinsville sand. Typical changes in clay mineralogy along weathering profiles, such as loss of chlorite, and an upward gain of interstratified clay minerals (Willman et al., 1963; Curry, 1989) are also lacking. These characteristics are common in Lierle Clay (figs. 8 and 9) and the

overlying Berry Formation (fig. 10), both of which were pedogenically modified during interglacial episodes.

In the overlying Petersburg Silt, weakly developed soils, snail fauna, coniferous wood fragments, silt content, and laminations indicate deposition in an ephemeral lake under periglacial or glacial conditions. Pedogenic alteration of Petersburg is restricted to a few leached, organic-rich horizons that possess silt-coatings on platy peds, and abundant root traces.

In addition to information from this report, data from borings near Martinsville indicate that during initial aggradation of the bedrock valleys, streams flowed southward (Battelle Memorial Institute and Hanson Engineering, 1990a; Curry et al., 1991). Accordingly, the Petersburg Silt was deposited possibly in a slackwater lake, or a stream that shoaled towards a lake. The lake would have formed by the aggrading Ancient Wabash River system during Illinoian glaciation.

Glasford Formation - Environment of Deposition of Diamicton (Till)

Overlying the Petersburg Silt, till members belonging to the Glasford Formation are the thickest and most widespread lithostratigraphic units beneath the MAS. Special discussion of their genesis is warranted to help explain lithologic features and distribution across the site. Generally, three types of till related to processes of deposition within the glacier are recognized: lodgement, deformation, and meltout till. Determining what processes predominated during till deposition requires careful study of outcrops or core because sedimentary structures characteristic of one process may have been subsequently modified to varying degrees by another process (Boulton, 1987; Hicock, 1990).

Lodgement and deformation tills are interpreted to have been deposited by active ice; lodgement till by debris released at the base of a sliding glacier; and deformation till by underlying sediment that is deformed and moved by shear imparted by the glacier, but not incorporated into the glacial ice. Lodgement till commonly is interpreted to have been deposited by sliding "warm-based" glaciers that abraded bedrock surfaces or covered paleosols or proglacial sequences with little or no deformation. Evidence for deposition by a shearing or sliding glacial bed in a lodgement environment includes bullet-shaped cobbles, strong pebble fabric, and channels filled with sand and gravel with U-shaped bottoms in diamicton (Eyles, 1983; Drewry, 1986; Johnson and Hansel, 1990). Deformation till includes masses of sediment whose primary sedimentary structure or sequence has been disturbed (Boulton, 1987). Deformation till contains abundant fragments of underlying lithologies, and the lower contact is erosional as indicated by truncated subsequences. Deformation and lodgement may be closely related; for example, diamicton originally deposited by lodgement processes may be deformed later.

The deforming-bed theory of till deposition has only recently been advanced (Boulton, 1987; Boulton and Hindmarsh, 1987; Alley et al., 1987), and it has been suggested that many tills thought to have been deposited by lodgement were in fact deposited in a deforming bed with intensive, pervasive shear.

Meltout till contains evidence for passive melting of interstitial ice that commonly results in deposits of sorted sediment and diamicton modified by soft sediment deformation with relatively weak pebble fabric. Examples of sedimentary structures associated with meltout till are sand and gravel stringers draped over cobbles or boulders (Shaw, 1988). Meltout till may be deposited in a subglacial environment, or in the upper portion of an ablating glacier from which it subsequently may be redeposited by mass wasting processes, such as sediment gravity flow (Lawson, 1982).

Smithboro Till Member

The Smithboro Till Member of the Glasford Formation was deposited by the earliest Illinoian glacier in the region. The silt loam diamicton facies of the Smithboro is characterized by its great thickness and abundant inclusions of weathered bedrock, Martinsville sand, and most commonly, Petersburg Silt. The Smithboro possesses a clay mineral composition similar to that of weathered sediment. Well-preserved fossil gastropods in the Smithboro suggest that underlying sediment

was incorporated as blocks with little internal deformation. Shearing also is indicated by crude layering of silt loam and organic-rich silty clay loam suggestive of remolding of primary stratification, and by strongly developed platy structure.

The great thickness of the Smithboro at the MAS probably is due to incorporation of Petersburg Silt, which was at least 50 feet thick in the bedrock valleys before the earliest Illinoian glacier covered the area. Several deformational processes may account for the thick sections of lacustrine silt incorporated in both facies of the Smithboro (figs. 15 and 16). For example, a cold-based glacier may have incorporated inclusions of frozen Petersburg Silt, or alternatively, a warm-based glacier may have deformed normally or underconsolidated, saturated sediment. Differences in texture of the silt loam diamicton facies may be explained by relative degrees of shearing and remolding of sediment.

Sediment and structural heterogeneity of the silt loam diamicton facies is greater than the loam diamicton facies. The latter facies contains more sand, carbonate, and illite, and less silt and expandable clay minerals than the silt loam diamicton facies. These characteristics indicate that sediment primarily originated from the Lake Michigan Basin and northern Illinois sources. This also is a characteristic of the Vandalia Till Member. The relative contributions of the far-traveled material increases upsection in the Smithboro. In the deforming bed model of till deposition, the loam diamicton facies may have been influenced by more pervasive shear than when the silt loam diamicton facies was deposited. Alternatively, the loam diamicton facies may have been deposited by lodgement or regelation with less subglacial deformation (Drewry, 1986). In either scenario, the composition of the sediment at the base of the glacier changed as the local sediment became covered with till, and thus less likely to be entrained by the glacier. Composition of sediment higher in the sequence, therefore, was influenced by proportionally more far-traveled sediment. The result is a till composition in the loam diamicton facies that generally is less silty and contains more illite relative to expandable clay minerals than till lower in the sequence.

Mulberry Grove Member

The distribution and physical characteristics of facies in the Mulberry Grove Member indicate deposition in proglacial and subglacial environments, primarily the latter. Sequences that in part are composed of the pedogenically modified and fossiliferous silt facies, such as core from borings M-03, M-07, and M-111, are interpreted to have been deposited subaerially; sequences composed in part of diamicton and unaltered gray silts that have a Vandalia-like mineralogy are interpreted to have been deposited in subglacial or ice marginal environments (figs. 18 and 24). Evidence for the subaerial and subglacial environments of deposition is illustrated by discussing features shown in figure 13. Evidence for subaerial proglacial environments includes pedogenically altered silt at the base of M-07 (see also fig. 16). Immediately west of CLK-02-03, Smithboro Till has been truncated due to subglacial erosion during deposition of the Mulberry Grove and Vandalia Members (figs. 14 and 19). Elsewhere across the MAS the sand and gravel facies may have been deposited in either subglacial or subaerial environments.

The Mulberry Grove Member probably was deposited subglacially across much of the MAS. The diamicton facies typically possesses the physical and mineralogical characteristics of the overlying Vandalia Till Member, suggesting that part of the Mulberry Grove and Vandalia were deposited by the same glacial advance. The diamicton also may have been deposited subaerially as debris flows, but the lithologic succession does not indicate a proglacial sequence, such as a coarsening-upwards sequence of sand and gravel (Eyles, 1983; Ashley et al., 1985). Moreover, a subglacial origin is suggested in areas where the Vandalia is anomalously thick and is underlain by the Mulberry, such as near CLK-02-03 (fig. 13). Subglacial environments are interpreted to have been most prevalent adjacent to and south of M-112 along the MAS bedrock valley, including part of the North Fork Embarras bedrock valley (fig. 24). Sediment sequences from the base to top suggests that subaerial deposits are overlain by subglacial deposits (fig. 18; borings M-07, M-106, and M-111, for example).

Thick Mulberry Grove Member occurs under the eastern part of the modern North Fork Embarras River valley adjacent to the MAS (figs. 11, 12, 13, and 17), and consists of interbedded diamicton and sand and gravel. The topography of the lower surface of the Mulberry Grove Member (fig. 25) indicates that most of these sediments may have been deposited in subglacial or ice marginal drainageways associated with the glacial advance that deposited the Mulberry Grove and Vandalia Till Members. Relatively little relief of the lower surface of the Vandalia in the area indicates the channels were filled with the Mulberry Grove before or during deposition of the Vandalia Till Member (fig. 26).

Uniform Diamicton Facies, Vandalia Till Member

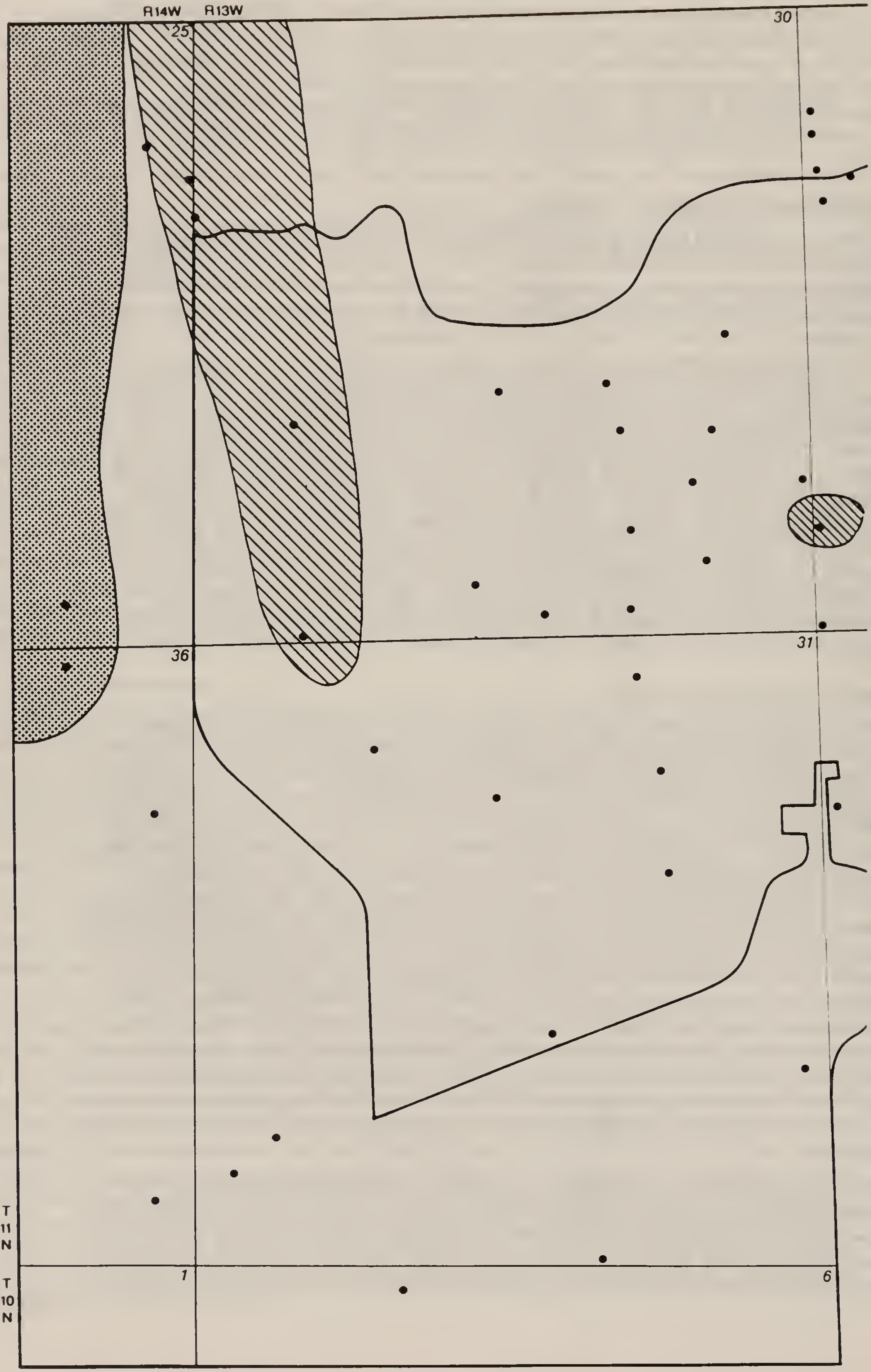
The second advance of Illinoian ice in the region deposited the Vandalia Till Member and part of the Mulberry Grove Member of the Glasford Formation. The homogeneity of texture and lack of primary or deformed sedimentary structure suggest the uniform diamicton facies of the Vandalia was deposited by lodgement (Eyles, 1983; Ashley et al., 1985) or in a pervasively deforming bed (Alley et al., 1987).

The genesis of anomalously thick Vandalia and deep Mulberry Grove sand and gravel near M-112 and CLK-02-03 (figs. 11, 13, and 19) is not understood. In the literature such a shallow cone filled with glacigenic diamicton is unknown from outside the study area. A great change in the thickness of the Vandalia, from about 30 to more than 60 feet, was observed at Wilsonville, Illinois (Follmer, 1985), but the morphology of the anomaly is not known. The cone-shaped anomaly at the MAS is located just north (up ice) of a small ridge of sandstone bedrock that restricts the width of the MAS bedrock valley near M-103 (fig. 6). A narrower valley segment also may be near M-01 and M-125 (fig. 5) where there is a large difference in the piezometric head in the sand and gravel facies of both the Martinsville sand and Mulberry Grove Member (Battelle Memorial Institute and Hanson Engineers, 1990b). This constriction may have had several effects on the behavior of the Vandalia glacier. For example, the bedrock ridge or valley constriction may have caused glacial flow to have become more compressive (Drewry, 1986), resulting in local erosion.

Mélange Facies, Vandalia Till Member

The mélange facies of the Vandalia Till Member was deposited by a combination of subglacial processes, and modified by passive loading and dewatering in relatively stagnant, debris-rich ice. At outcrop CC-16, subparallel, discontinuous layers, lenses, and pods of well-sorted, medium-grained sand as much as 3 feet thick and 30 feet long, are interbedded with layers of loam diamicton and uniform silt that form irregular, intermingled pods and convoluted laminae (figs. 27 and 28). The upper contacts of the sand layers commonly are irregular and wavy, which possibly was caused by soft sediment deformation during deposition and dewatering. The loam diamicton above and below the sand layers contains numerous wavy sand partings, and yields pebble macrofabrics with poorly expressed preferred orientation (S1 values of 0.58 and 0.66 for macrofabrics A and B, respectively, in fig. 27) (see Lawson, 1982, for a discussion of the interpretation of pebble macrofabric data). These data are interpreted to be indicative of deposition as melt-out till. Along Bluegrass Creek the mélange facies at CC-16 yields a pebble fabric (macrofabric C in fig. 27) with a stronger preferred orientation (S1 value of 0.81) approximately S 30 W, the inferred direction of ice movement. The diamicton also contains abundant striated, bullet-shaped cobbles. Such characteristics are interpreted to indicate deposition by lodgement (Lawson 1982; Johnson and Hansel, 1990). Thus, the mélange facies at CC-16 appears to have been deposited in a stagnating, ice-marginal environment as lodgement till at the base with an upward increasing deposition by melt-out.

The mélange facies at outcrop CC-15 consists of irregularly shaped pods of gravelly sand that are associated with thin layers of loam diamicton (fig. 29). Mixing of gravelly sand and diamicton did not occur, although diamicton layers are commonly less than 1 mm thick. Brittle fracturing of the sand and gravel, followed by filling of the fractures with fluid diamicton, may be explained by high hydrostatic pressure and dewatering during deposition. Because a larger volume of ice or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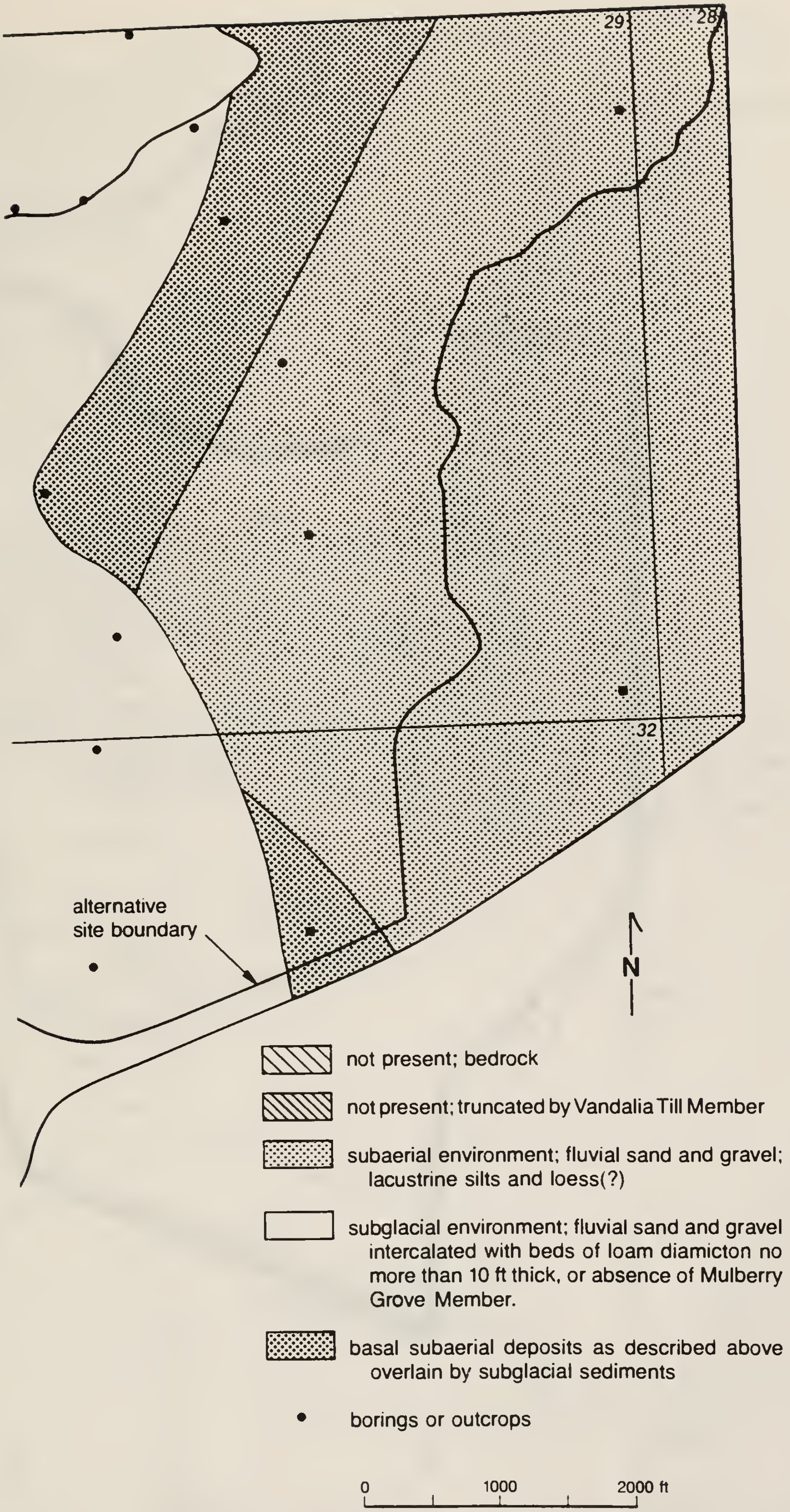
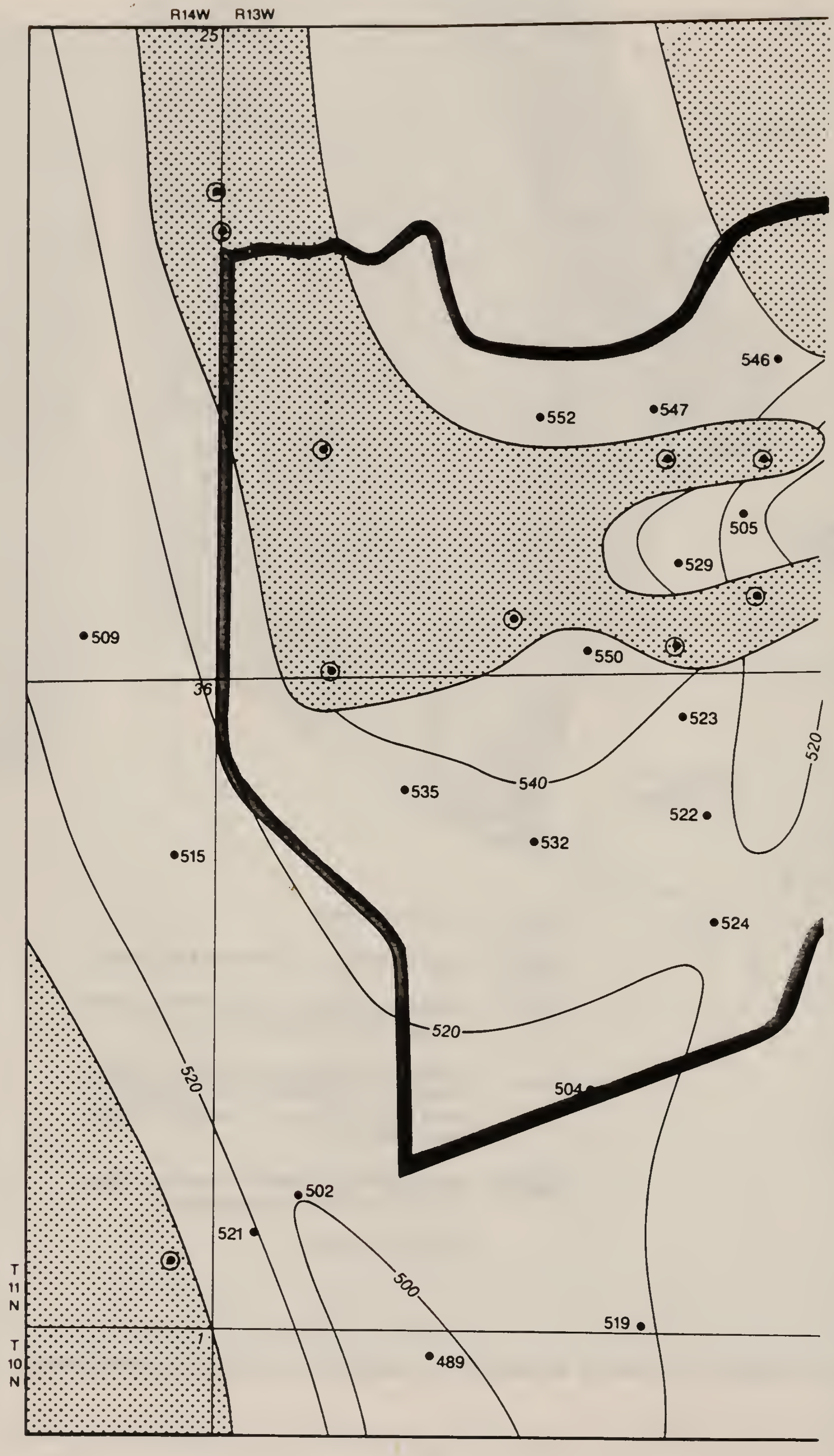


Figure 24 Interpreted environment of deposition of the Mulberry Grove Member, Glasford Formation.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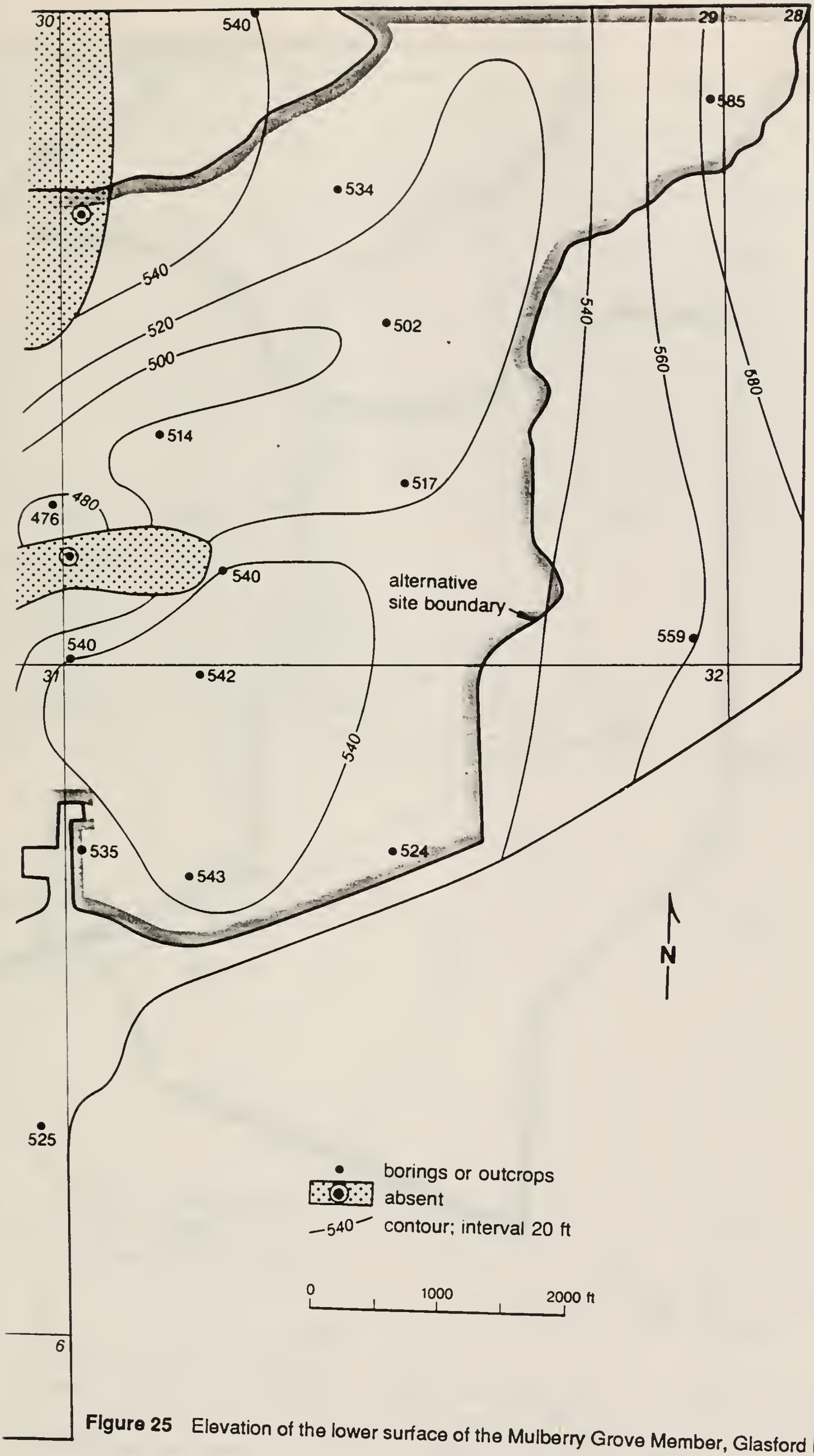
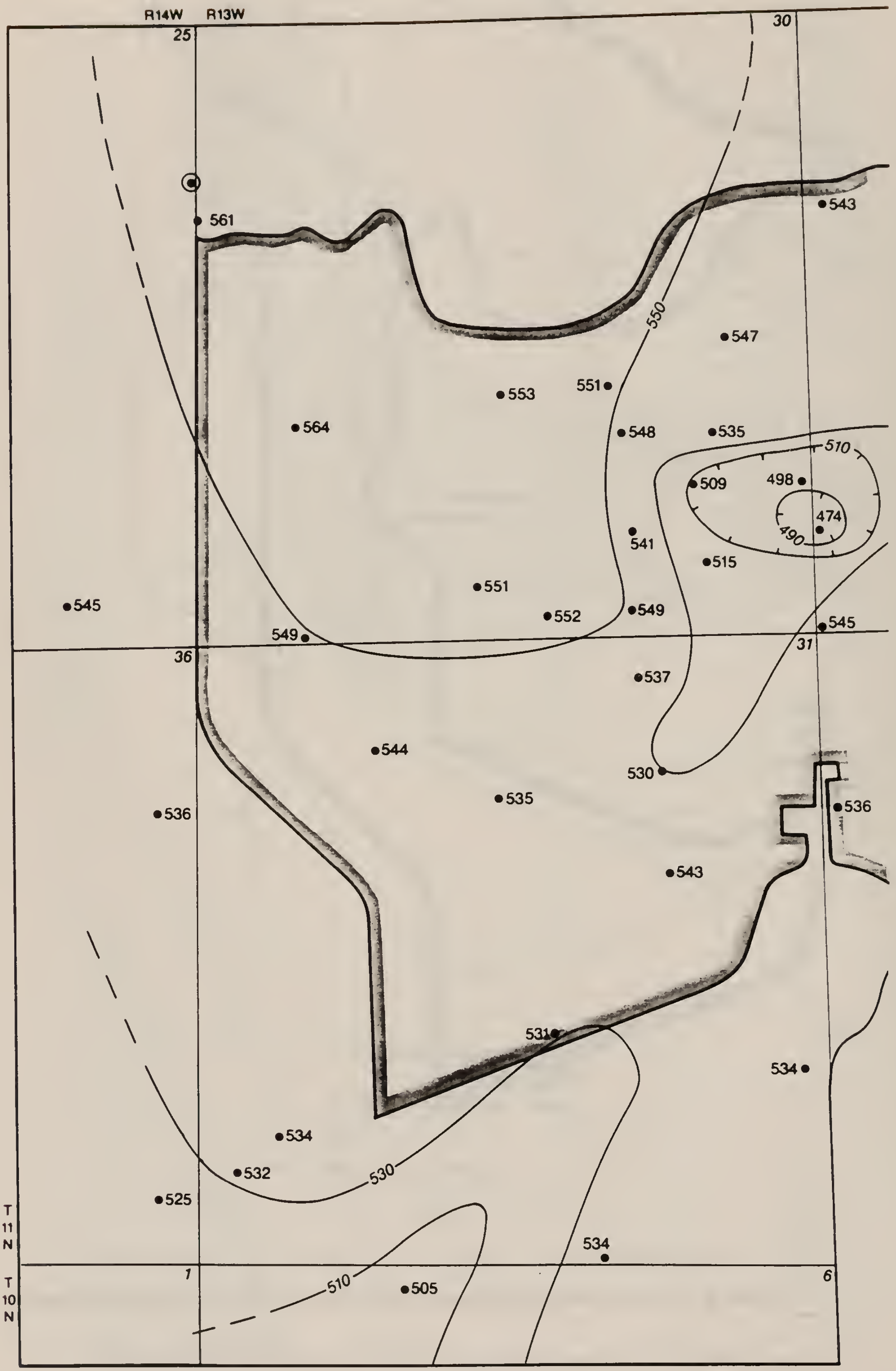


Figure 25 Elevation of the lower surface of the Mulberry Grove Member, Glasford Formation.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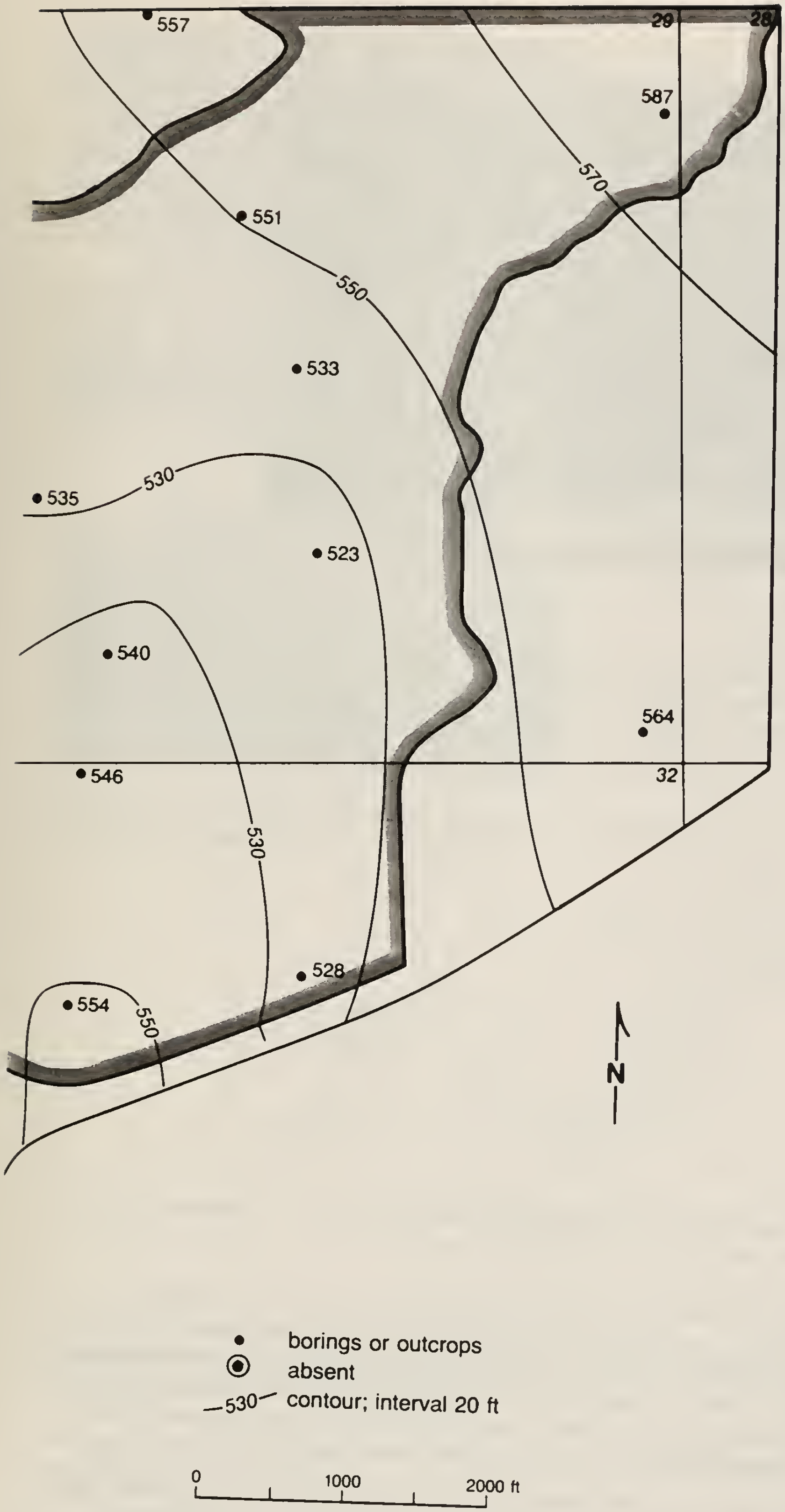

Figure 26 Elevation of the lower surface of the Vandalia Till Member, Glasford Formation.

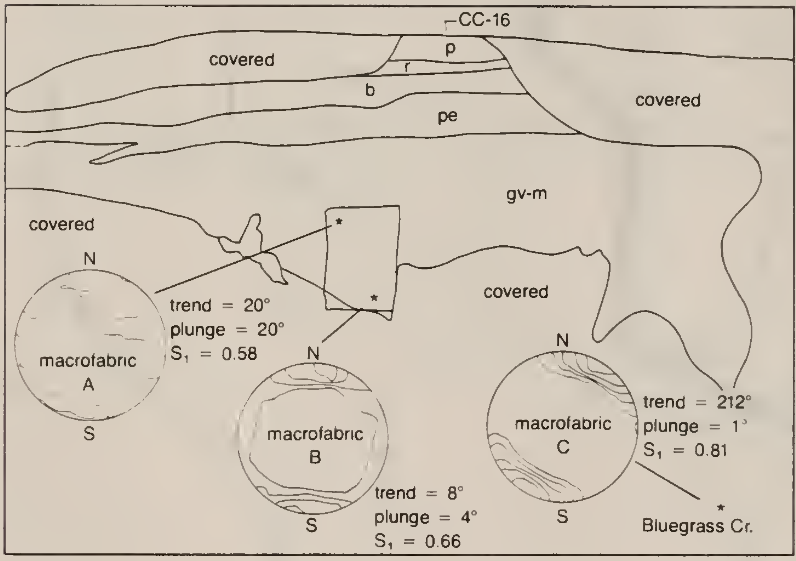

Figure 27 Outcrop CC-16 along Bluegrass Creek, immediately north of the MAS, and pebble macrofabrics from the mélange facies of the Vandalia Member of the Glasford Formation.

water would be in contact with grain surfaces in the diamicton than in those of the sand and gravel, it is possible that, with loading, the interstitial water in diamicton was fluid while the interstitial water in the sand and gravel remained frozen. Under great hydrostatic pressure and tensional shear stress, the bodies of sand, gravel, and ice may have deformed as a brittle solid while the surrounding diamicton was fluid, and passively filled in the voids between fracture faces. Discontinuities in the mélange facies and uniform diamicton facies commonly contain little or no filling.

The precise mechanism that formed the discontinuities is not well understood, and it is likely that there were multiple modes or episodes of formation. Potential mechanisms include 1) failure (faulting) during dewatering and melting of the glacier bed and overlying ice due to differential settling, 2) shearing after reactivation of ice movement, and 3) differential movement of the glacier

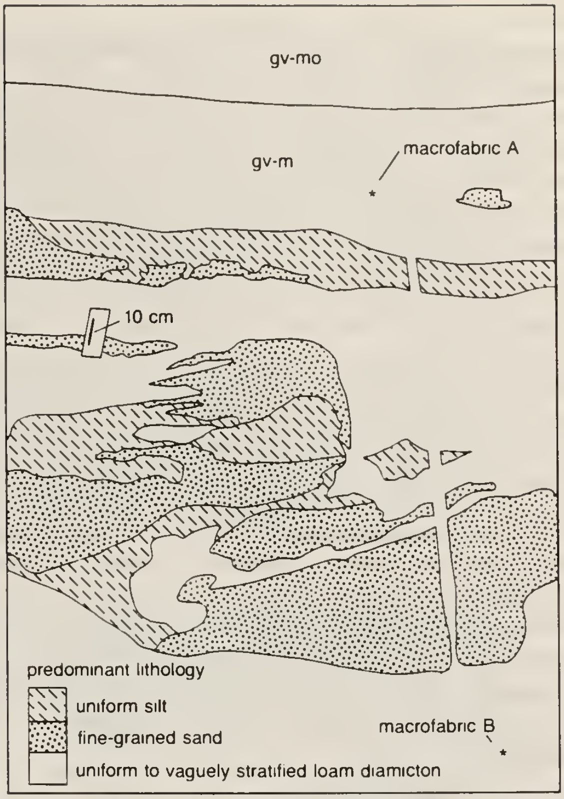

Figure 28 Sediment types of the mélange facies of the Vandalia Member of the Glasford Formation at CC-16. Area photograph outlined in figure 27.

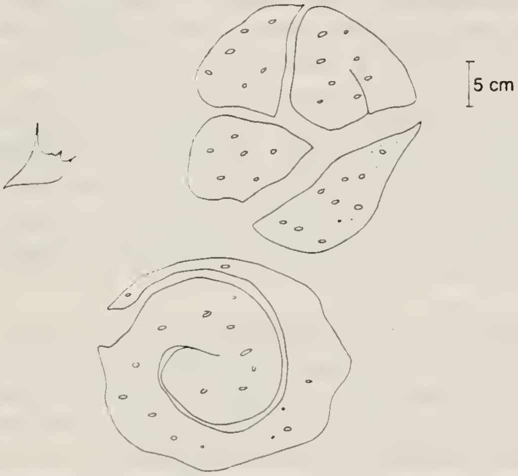

Figure 29 Sand and gravel bodies (stippled) in loam diamicton of the mélange facies suggestive of soft sediment deformation under hydrostatic loading.

bed during deposition. Other possible mechanism are discussed in Battelle Memorial Institute and Hanson Engineers (1990a).

Post-Illinoian Deposits, Weathering, and Development of Stream Network

Sediments that overlie the Vandalia Till Member on the uplands are less than 20 feet thick, and include sand and gravel, lacustrine sediments, eolian sand (Pearl Formation), colluvium (Berry For-

mation and the sandy silt facies of the Roxana Silt), and eolian silt and sand (Peoria Loess and Parkland Sand). All supra-Vandalia sediments have been modified to some degree by pedogenesis during the Sangamonian, Wisconsinan, and Holocene Ages (Follmer, 1983). Sediments deposited during these periods and associated ancient soils can be distinguished most easily where sediments are thick, such as in loess along the Illinois River valley. At the MAS, however, Roxana Silt generally is less than 3.0 feet thick, possesses no loess-like character, and has physical properties like the underlying Berry Formation. Were it not for regional relationships, a tenable interpretation at the MAS might be that only one Wisconsinan loessial unit is present, and its lower portion is pedogenically mixed with the Berry Formation.

Throughout the study area, the Sangamon Soil occurs on uplands, as well as along gentle valley slopes extending to about 30 feet above the major streams. The depth of leaching and other pedogenic alteration below these slopes is shallower than on the uplands (for example, the thickness of Berry Clay at CC-16 and M-07 is 2 and 8 ft, respectively). This, in addition to a mantle of Wisconsinan loess above the Sangamon Soil, indicates that sediment was transported along the slopes during the late Sangamon (Johnson et al., 1972).

The age of postglacial sediments in valleys adjacent to the MAS is not as well understood as sediments on the uplands at the MAS. Section B-B′ across the North Fork Embarras River valley (fig. 12) indicates that the valley widened after the Illinoian Age. The lower part of the Sangamon Soil, developed in Vandalia diamicton, is present to an elevation of about 610 feet along the valley flanks. The Sangamon and Farmdale Soils, Berry Formation, and Roxana Silt are not recognized in the valley fill; therefore, determining the age of these sediments is tenuous. Generally, the age of calcareous alluvium probably is Illinoian and Wisconsinan, where as leached alluvium is Holocene.

It is possible that from the Illinoian to the present, the lowest elevation Bluegrass Creek attained during periods of downcutting was about 557 feet, the elevation of the bedrock surface at M-120 near the mouth of Bluegrass Creek (fig. 2). At about 14,500 B.P., the mouth of Bluegrass Creek was no more than about 4 feet above its present level of about 575 feet, as indicated by radiocarbon age ISGS-2024 on wood from a depth of about 11 feet at M-120. In the mid reaches of Bluegrass Creek, an age of 23,720 300 B.P. (ISGS-2110) was obtained from wood collected between outcrops CC-16 and CC-17 (fig. 2). The sample is buried by about 7 feet of Cahokia Alluvium and occurs about 0.5 feet below Bluegrass Creek that flows at about 590 feet above sea level during low flow. This suggests net aggradation in the valley some time after 14,000 B.P., followed by incision to present stream levels during an unknown period. The alluvial history of the valley of the North Fork Embarras River is less understood and probably more complex than that of Bluegrass Creek because of the former's greater basin area and erosion due to the discharging of meltwater.

Development of the drainage network on and immediately adjacent to the MAS may have begun after deposition of the Pearl Formation and upper Vandalia Till Member. Alternatively, the present form of the North Fork Embarras valley may be related to subglacial drainage of the glacier that deposited the Mulberry Grove and Vandalia Till members. Proglacial, ice marginal, and subglacial discharge above the Smithboro Till Member, as well as focused and more rapid flow of glacial ice into the partly filled North Fork Embarras bedrock valley (fig. 25), would lead to thick deposits of the Mulberry Grove Member, and relatively thin deposits of Vandalia diamicton. Such discharge may not have been effective along the MAS bedrock valley due to the narrow valley segment postulated above. Thus, differences in glacially related discharge may explain the greater abundance of Mulberry Grove sand and gravel facies in the North Embarras bedrock valley compared to deposits in the Martinsville bedrock valley. Boulton and Hindmarsh (1987) described a similar model of subglacial deposition in the development of tunnel valleys under warm-based glaciers. In either scenario, the absence of Sangamon Soil in the deposits below the valley of the North Fork Embarras River indicates some Sangamonian or early Wisconsinan erosion in the valley.

SUMMARY AND CONCLUSIONS

Quaternary deposits beneath the MAS fill two buried bedrock valleys (the Martinsville Alternative Site and North Fork Embarras bedrock valleys) above chiefly sandstone, siltstone, and shale of the Pennsylvanian Bond Formation and Modesto Formation. The MAS bedrock valley had not been mapped prior to investigations at the site. The Quaternary stratigraphic succession at the MAS is unique in the region because no pre-Illinoian diamicton is present, but it is found 3 miles to the east. The thickness of each primary Illinoian lithostratigraphic unit, including Petersburg Silt, and Smithboro Till Member, Mulberry Grove Member, and Vandalia Till Member of the Glasford Formation, is the greatest known in Illinois. Thickness of the glacial drift varies from about 70 to more than 200 feet at the alternative site, and is absent in the Bluegrass Creek valley just north of the site.

The base of the Quaternary sequence at the MAS is the Yarmouthian Lierle Clay, composed of pedogenically altered sediment no more than 2 feet thick. Lierle Clay is present on the flanks of the buried bedrock valleys, but not along the valley bottoms, which suggests no more than about 25 feet of downcutting during deposition of the overlying alluvium, colluvium and overbank sediments, informally named Martinsville sand. Limited clay mineral alteration and locally abundant coniferous wood fragments indicate that the Martinsville sand was deposited under cool climate, and is of earliest Illinoian age.

The Martinsville sand is overlain by as much as 50 feet of Petersburg Silt, interpreted as slackwater lacustrine sediment. Measurement of amino acid racemization of gastropod shells confirms correlation of the sediment with the Petersburg Silt in the type area. Silt loam and loam till of the Smithboro Member of the Glasford Formation, as much as 97.2 feet thick, overlie the Petersburg. The Smithboro is interpreted to have been deposited as subglacial till, either dominantly by lodgement processes or by a deforming bed. The overlying Mulberry Grove Member comprises three facies composed of diamicton, sand and gravel, and silt. Pedogenically altered, fossiliferous silts indicate that some of the Mulberry was deposited in a subaerial proglacial environment, but these sediments also could be inclusions of Petersburg Silt. The bulk of the Mulberry Grove, deposited in subglacial and subaerial ice marginal environments, is composed of sand and gravel as much as 28 feet thick and diamicton, no more than 10 feet thick. The clay mineral composition and matrix texture of the diamicton are typically similar to those of the overlying Vandalia Till Member.

The Vandalia Till Member of the Glasford Formation has two facies: a lower uniform diamicton and a mélange facies. The uniform diamicton facies, as much as 129 feet thick, is composed of loam diamicton deposited subglacially by lodgement or by pervasive shear in a deforming bed. Subglacial channels filled with poorly sorted sand and gravel as much as 19 feet thick occur in the uniform diamicton facies; however, the length, continuity, and width of the channels are unknown. The mélange facies, as much as 26 feet thick, typically overlies the uniform diamicton facies. The mélange consists of chiefly loam diamicton, less sand and gravel, and subordinate silt. The mélange facies was deposited in subglacial and ice marginal environments.

The Glasford Formation is overlain discontinuously by sand and gravel, and subordinate silty clay of the Pearl Formation that is as much as 13 feet thick. The supra-adjacent Berry Formation is composed of leached loam and clay loam diamicton about 13 feet thick. The Pearl and Berry, as well as the upper mélange facies of the Vandalia, are leached and pedogenically modified by the Sangamon Soil. The latter imparts features such as subangular blocky structure, sesquioxide concretions, and cutans. Berry Formation is overlain by Wisconsinan loess about 7 feet thick, including a lower zone of pedogenically mixed loess and weathered sediment composed of loam (Roxana Silt) and loessial silt loam (Peoria Loess). Both units are pedogenically modified: the Roxana by the Farmdale Soil and modern soil and the Peoria by the modern soil.

Streams and terraces along the North Fork Embarras River, Bluegrass Creek, Kettering Branch, and smaller valleys are underlain by Cahokia Alluvium, which is as much as 35 feet thick and composed of coarse granular sediment, well-sorted medium sand, loam, and silt loam. Radiocarbon ages of 23,720±300 yr B.P. (ISGS-2113), 14,490 ±140 yr B.P. (ISGS-2024), and 320 ±70 yr

B.P. (ISGS-2073) from wood within the Cahokia indicate an age of late Wisconsinan to Holocene. Due to the lack of Roxana Silt, Berry Formation, or the Sangamon Soil, the presence of late Wisconsinan sand and gravel (outwash) cannot be confirmed in the valley of the North Fork Embarras River. Although stratigraphic confirmation is lacking, late Wisconsinan outwash is likely present in the valley fill because the North Fork Embarras River heads on the Shelbyville Morainic System, 8 miles north of the Martinsville Alternative Site.

Development of the drainage network on and immediately adjacent to the MAS probably began in the Illinoian during and after deposition of the Pearl Formation and the mélange facies of the Vandalia Till Member. An alternate hypothesis is that much of the relief across the valley of the North Fork Embarras River developed during deposition of the Mulberry Grove Member and the Vandalia Till Member. In this scenario, the proto-North Fork Embarras River valley was initially a large conduit for proglacial and subglacial discharge; less diamicton is present in the valley not due to erosion, but due to diamicton never having been deposited there. When the Vandalia glacier melted, the valley of the North Fork Embarras River may have been a route for meltwater discharge from continued glacial activity during the Illinoian to the north of the MAS (Johnson et al., 1972; Lineback, 1979a, b), and finally a route for drainage during the Sangamonian, Wisconsinan, and Holocene.

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APPENDIX

Location and laboratory data for cores (Battelle Memorial Institute and Hanson Engineers, 1990c).

Key to listing of laboratory data

Unit symbol	Unit
l	Lacon Formation
c	Cahokia Alluvium
pey	Peyton Colluvium
p	Peoria Loess
pks	Parkland Sand
r	Roxana Silt, sandy silt facies
b	Berry Formation
pe	Pearl Formation
	Glasford Formation
	Vandalia Till Member
gv-m	mélange facies
gv-u	uniform diamicton facies
	Mulberry Grove Member
gm-d	diamicton facies
gm-z	sand and gravel facies
gm-s	silt facies
	Smithboro Till Member
gs	loam diamicton facies
gs-s	silt loam diamicton facies
ps	Petersburg Silt
	Martinsville sand
ms-d	diamicton facies
ms-z	sand and gravel facies
ms-s	silty clay facies
	Banner Formation
bl	Lierle Clay Member
bc	Casey till member
Plm, Pb	Modesto or Bond Formation

Suffixes

-o oxidized (e.g. bc-o = oxidized Casey Till Member; C1, C2 or C3 horizon of Sangamon or Yarmouth Soils)
-x significant pedogenic alteration (B horizon of Sangamon or Yarmouth Soils)
-z sand and/or gravel inclusive of unit

Column headings

Tot gvl = total gravel in subsample (> 2000 μm)
mm fraction, SD% = sand (63-2000 μm)
mm fraction, ST% = silt (4-63 μm)
mm fraction, CL% = clay (<4 μm)
Cu = coefficient of uniformity
W% = moisture content
LL = liquid limit
PL = plastic limit
PI = plasticity index
EXP = expandable clay minerals
ILL = illite

C-K = chlorite plus kaolinite; note that EXP + IL + C-K = 100%
Cal = calcite (in counts per second)
Dol = dolomite (in counts per second)
VERM IND = vermiculite index
DI = diffraction intensity ratio
HSI = heterogeneous swelling index
INT CPS = total counts per second, uncorrected, for EXP + IL + C-K

Laboratory data for samples

BOREHOLE # M-01
ELEVATION: 625.9 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
DEP TOP	DEP BOT	UNIT	TOT GVL %	SD %	<2mm ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
4.5	5.0	pks	1	68	21	11	127.5	16.1	20		9	46	33	21	0	0	38>	1.0	4	1470
9.5	10.0	r	2	33	39	28	26.1	19.7	29	11	18									
12.5	13.0	b	2	33	35	32	32.5	21.7	30	12	18									
14.5	15.0	gv-mo	3	41	36	23	74.2	23.8	26	15	11	13	72	15	0	0	4>	3.3	0	1370
17.5	18.0	gv-mz	1	93	6	1	3.4	25.9												
19.5	20.0	gv-m	2	32	58	10	13.7	10.2	20	11	9	12	60	28	33	24	8>	1.5	X	1640
24.5	25.0	gv-mz	1	95	3	2	2.7	19.0												
29.5	30.0	gv-m	3	60	26	14	104.5	7.7	15	11	4	9	61	30	50	32	3>	1.4	X	2290
34.9	35.4	gv-u	5	51	30	19	129.6	7.6	21	11	10	14	56	30	75	50	10>	1.2	X	2690
39.5	40.0	gv-u	3	46	30	24	92.0	7.9	21	11	10									
44.5	45.0	gv-u	4	23	54	23	23.2	10.4	29	16	13									
49.5	50.0	gv-u	5	48	31	21	114.8	9.8	22	11	11	9	60	31	60	30	2>	1.3	X	2120
54.5	55.0	gv-u	8	45	31	24	100.7	11.1	23	12	11									
59.5	60.0	gv-u	6	44	33	23	86.6	10.5	24	12	12									
64.5	65.0	gv-u	8	45	34	21	105.1	11.0	23	12	11									
69.5	70.0	gv-u	7	46	34	20	108.3	8.4	21	12	9	11	58	31	33	33	8>	1.3	X	1960
71.0	71.5	gv-z	8	70	18	12	37.8	14.2	26	13	13									
74.5	75.0	gv-u	5	32	42	26	75.6	11.4												
78.3	78.8	gv-u	3	49	35	16	59.2	11.1	25	14	11									
79.5	80.0	gv-u	3	43	34	23	98.4	12.9	20	11	9									
84.5	85.0	gv-u	7	45	35	20	101.8	10.5	21	12	9									
89.5	90.0	gv-u	11	45	35	20	132.4	9.9	19	12	7	15	54	31	35	40	8>	1.2	X	2270
92.5		gv-u										15	56	29	36	28	12>	1.3	X	2410
94.5		gm-z	22	57	30	13	94.1	12.9	17	13	4									
95.7		gm-z	23	73	18	9	67.0	11.4												
101.5	102.0	gm-s	3	28	62	10	11.1	16.9				10	58	32	35	40	1>	1.2	X	2470
108.5	109.0	gm-d	7	42	44	14	10.8	11.4				8	62	30	35	33	1>	1.3	X	1700
109.5	110.0	gm-z	10	82	15	3	36.9	11.2	17	14	3									
110.1		gm-d										22	53	25	40	38	15>	1.4	0	2670
115.0		gm-d										21	50	29	44	30	16>	1.1	1	2350
118.2	118.7	gm-d	6	40	40	20	70.1	11.1	21	12	9	16	55	29	40	43	10>	1.2	0	2850
119.5	120.0	gm-d	5	41	39	20	70.0	11.2	25	13	12	30	49	21	46	37	22>	1.5	4	3010
119.8		gm-d										26	49	25	30	35	20>	1.3	2	2880
122.5		gs										23	52	25	36	30	17>	1.2	5	2730
124.5	125.0	gs	7	37	43	20	47.5	12.9	23	13	10	29	48	23	42	35	23>	1.4	2	2400

BOREHOLE # M-01
ELEVATION: 625.9 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
129.5	130.0	gs	2	29	49	22	32.4	13.1	27	14	13	29	43	28	35	42	26>	1.0	1	1760
134.0	134.5	gs	2	26	52	22	30.6	16.6	29	15	14									
139.5	140.0	gs-s	2	24	54	22	25.3	18.3	29	16	13									
144.5	145.0	gs	13	59	27	14	188.2	11.8	19	13	6									
149.5	150.0	gs-s	1	23	48	29	21.5	16.8	31	16	15									
154.2	154.7	gs-s	1	21	50	29	19.6	20.8	34	16	18	27	44	29	35	25	25>	1.0	2	2250
159.5	160.0	gs	2	51	22	27	20.0	23.2	32	18	14	34	39	27	0	0	30>	1.0	3	2320
163.7	164.2	gs	4	52	30	18	121.9	17.1	27	22	5									
169.5	170.0	ms-z	3	88	8	4	11.5	42.5												
174.5	175.0	ms-z	11	89	6	5	4.8	39.1												
183.5	183.7	ms-z	21	81	13	6	53.5	9.6												

BOREHOLE # M-02
ELEVATION: 623.5 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
4.5	5.0	r	3	21	46	33	16.7	19.4	32	14	18	64	19	17	0	0	44>	1.6	9	3240
9.5	10.0	b	3	39	33	28	68.0	18.4	37	12	25	30	50	20	0	0	24>	1.6	2	1450
14.5	15.0	gv-mo	4	44	32	24	74.8	10.1	22	11	11	28	52	20	47	35	19>	1.7	1	2690
19.5	20.0	gv-m	6	40	40	20	62.9	9.8	35	12	23	15	54	31	37	30	10>	1.2	X	2590
24.5	25.0	gv-u	5	38	41	21	54.9	10.3	23	12	11	16	56	28	48	55	8>	1.3	1	3100
26.6	27.2	gv-u	5	31	36	33	35.9	9.3	21	12	9									
29.5	30.0	gv-u	9	35	40	25	56.9	8.4	25	12	13	25	49	26	46	40	15>	1.2	1	3510
34.5	35.0	gv-u	7	38	40	22	58.7	8.5	22	13	9	18	54	28	25	30	8>	1.3	2	3080
39.5	40.0	gv-u	10	30	48	22	42.4	11.0	24	14	10	36	42	22	38	31	21>	1.3	4	3180
44.5	45.0	gv-u	11	33	37	30	49.2	11.0	28	13	15	14	52	34	37	22	12>	1.0	X	2650
49.5	50.0	gv-u	3	28	40	32	26.9	12.2	30	15	15	15	51	34	50	33	13>	1.0	X	3220
54.5	55.0	gv-u	2	31	40	29	36.0	10.5	29	14	15	10	56	34	32	0	8>	1.1	X	3180
59.5	60.0	gv-u	7	30	40	30	32.8	13.0	28	14	14	11	50	39	55	0	17>	0.8	X	3030
67.9	68.4	gv-u	11	31	41	28	44.4	19.5	30	14	16	12	50	38	35	25	11>	0.9	X	2620
69.5		gm-s										49	23	28	0	0	31>	0.5	6	3880
69.5	70.0	gm-s	0	19	51	30	23.7	16.5	34	14	20	53	22	25	0	0	32>	0.6	9	3100
72.0		bl										44	29	27	0	0	41>	0.7	7	2280
74.5	75.0	Pb	1	37	45	18	64.6	15.4	21	13	8	37	30	33	20	0	31>	0.6	1	2710
79.5	80.0	Pb	1	61	25	14	97.5	16.4	25	19	6	13	45	42	0	0	9>	0.7	1	1425
84.5	85.0	Pb	13	0	30	70	4.7	17.7	58	20	38	15	64	21	25	20	17>	2.0	X	1970
85.9	86.3	Pb	0	4	28	68	2.3	43.5	61	26	35	29	57	14	0	0	25>	2.8	X	5800
89.5	90.0	Pb	1	27	52	21	30.2	11.9	30	21	9	1	66	33	27	10	14<	1.3	X	5600

BOREHOLE # M-03
ELEVATION: 636.6 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
4.5	5.0	r	1	15	45	40	12.4	21.0	48	14	34									
9.5	10.0	b	1	21	44	35	17.0	19.7	41	13	28	82	9	9	0	0	55>	0.7	12	7070
14.5	15.0	gv-m	3	50	34	16	115.3	9.2	20	11	9	13	56	31	72	62	8>	1.2	X	2880
19.5	20.0	gv-u	3	45	32	23	77.4	7.6	22	12	10	20	49	31	52	40	17>	1.0	1	3030
24.5	25.0	gv-u	6	46	28	26	108.8	8.3	21	11	10	14	55	31	65	47	9>	1.2	X	2620
28.7	29.2	gv-u	4	47	32	21	97.0	11.0	23	12	11	16	52	32	60	37	11>	1.1	X	2890
34.5	35.0	gv-u	13	45	36	19	130.4	11.8	24	12	12									
39.5	40.0	gv-u	7	39	40	21	59.7	11.3	23	12	11									
44.5	45.0	gv-u	4	39	40	21	56.2	9.4	22	12	10									
47.0		gv-u										18	56	26	35	25	10>	1.4	2	2250
49.5	50.0	gm-s	2	14	71	15	18.9	15.3				21	55	24	28	28	16>	1.5	0	2375
51.4	51.9	gm-z	4	70	24	6	14.8	10.1												
	51.9	gs										31	46	23	40	40	21>	1.3	1	2550
54.5	55.0	gs	0	37	42	21	47.6	12.7	25	11	14	21	55	24	35	35	12>	1.5	2	2300
59.5	60.0	gs	8	34	44	22	48.0	13.0	25	14	11	31	48	21	33	25	21>	1.5	2	2620
64.5	65.0	gs	6	33	44	23	44.5	13.4	24	13	11	30	48	22	20	20	23>	1.5	0	1860
69.5	70.0	gs	2	28	52	20	33.8	14.0	26	16	10	26	48	26	26	25	22>	1.3	X	1860
74.5	75.0	gs	8	26	52	22	39.1	16.1	27	16	11	24	52	24	25	20	20>	1.4	1	1490
79.5	80.0	gs-s	2	22	60	18	27.2	16.5	25	16	9									
84.5	85.0	gs-s	5	20	58	22	27.2	17.0	26	16	10									
89.5	90.0	gs-s	1	22	60	18	29.1	17.7	28	17	11									
94.5	95.0	gs-s	2	21	61	18	26.7	17.4	26	18	8	25	49	26	25	19	22>	1.3	X	1880
99.5	100.0	gs-s	1	14	51	35	15.5	20.5	37	13	24									
104.5	105.0	gs-s	1	14	68	18	22.1	19.5	24	19	5									
109.5	110.0	gs-s	1	18	64	18	23.5	18.1	26	19	7									
114.5	115.0	gs-s	2	14	72	14	15.8	19.3	24	19	5	14	56	30	30	28	15>	1.3	X	1750
116.0	116.5	gs-s	0	7	76	17	20.1	30.7	32	27	5									
119.5	120.0	gs-s	1	13	70	17	22.5	18.0				20	53	27	20	15	17>	1.3	0	1690
124.5	125.0	gs	8	45	37	18	104.8	18.6	22	12	10	19	54	27	39	39	16>	1.3	X	2630
129.5	130.0	gs-s	5	17	65	18	25.0	18.0	26	18	8									
134.5	135.0	gs-s	8	17	62	21	26.0	25.2	30	18	12									
139.5	140.0	gs-s	1	13	70	17	22.7	21.4	27	20	7	20	49	31	32	30	18>	1.0	2	2170
143.3	143.9	ps	0	4	49	47	7.0	25.9	45	22	23									
143.9	144.5	ps	0	16	62	22	15.1	21.8	28	17	11	17	57	26	37	35	15>	1.4	X	2900
144.5	145.0	Pb	1	60	24	16	60.4	20.5	21	15	6									
149.5	150.0	Pb	0	8	44	48	4.9	15.1	41	20	21									

BOREHOLE # M-04
ELEVATION: 636.6 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
4.0	4.5	r	1	22	48	30	18.9	20.7	39	12	27	72	14	14	0	0	51>	0.7	10	3760
9.5	10.0	b	2	44	28	28	95.5	19.2	36	12	24	55	25	20	0	0	33>	0.8	4	1810
12.5	13.0	b	2	54	30	16	130.1	14.1	21	8	13	21	66	13	0	0	15>	0.8	4	1810
19.5	20.0	gv-m	2	51	33	16	105.0	7.9	18	11	7	8	63	29	71	45	3>	1.5	1	1810
24.5	25.0	gv-m	6	46	32	22	115.2	10.1	23	11	12	8	63	29	84	55	5>	1.5	X	2570
26.1	26.7	gv-m	6	51	31	18	142.7	6.7	20	11	9									
29.5	30.0	gv-u	10	44	36	20	113.7	9.4	22	11	11	13	58	29	51	28	9>	1.3	X	1970
34.5	35.0	gv-u	9	44	32	24	108.7	11.8	23	12	11									
39.5	40.0	gv-u	6	43	35	22	91.9	9.9	24	12	12									
44.5	45.0	gv-u	6	43	35	22	84.8	9.0	24	12	12									
49.5	50.0	gv-u	8	44	37	19	92.3	9.3	24	12	12									
54.5	55.0	gv-u	4	45	35	20	90.9	8.7	23	12	11									
59.5	60.0	gv-u	6	43	36	21	82.3	10.6	22	12	10	14	54	32	46	32	8>	1.1	X	2460
64.5	65.0	gv-u	4	44	35	21	82.8	7.6	23	12	11									
69.3	69.8	gv-u	9	49	35	16	91.9	9.4	20	12	8	16	57	27	45	35	8>	1.4	X	2540
74.5	75.0	gs-s	4	25	53	22	32.9	12.8	29	14	15	33	43	24	20	20	24>	1.2	3	2630
79.5	80.0	Pb	9	23	61	16	27.9	8.1	28	22	6	4	52	44	0	0	3<	0.8	X	5090

BOREHOLE # M-05
ELEVATION: 616.8 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP	DEP	UNIT	GVL	SD	ST	CL	Cu	W%	LL	PL	PI	EXP	ILL	C-K	CAL	DOL	VERM	DI	HSI	INT
TOP	BOT		%	%	%	%						%	%	%			IND			CPS
4.5	5.0	b	3	33	30	37	35.5	18.7	39	12	27									
6.5	7.0	b	3	36	26	38	43.1	21.2	37	14	23	67	23	10	0	0	38>	1.5	12	3140
9.5	10.0	gv-mx	4	52	23	25	137.6	13.9	22	12	10	15	72	13	0	0	8>	3.6	0	1790
14.5	15.0	gv-m	7	59	28	13	65.4	7.2				9	63	28	50	30	1<	1.5	X	2250
19.5	20.0	gv-m	6	51	31	18	131.7	9.0	17	11	6	10	58	32	75	50	4>	1.2	X	2870
21.5	22.0	gv-m	33	23	68	9	260.4	6.8	16	11	5									
29.5	30.0	gv-m	6	48	28	24	129.2	8.3	20	11	9	7	63	30	47	35	3<	1.4	X	2150
31.9	32.4	gv-m	1	45	46	9	14.8	11.9												
39.5	40.0	gv-u	6	45	34	21	98.3	8.7	23	12	11									
44.5	45.0	gv-u	6	45	32	23	94.5	9.0	22	11	11	14	54	32	50	32	8>	1.1	X	2880
46.1	46.5	gv-z	1	68	28	4	8.8	15.2												
54.5	55.0	gv-u	7	43	36	21	92.5	7.6	23	12	11	12	58	30	49	25	8>	1.3	X	2480
55.0	55.5	gv-u	7	47	32	21	112.2	10.1	23	12	11									
56.5	56.9	gv-u	15	45	33	22	140.3	11.3	23	12	11									
65.0	65.5	gv-u	17	42	36	22	131.1	11.4	22	12	10									
74.0	74.5	gv-u	38	48	33	19	903.6	12.7	23	12	11	14	59	27	50	50	8>	1.5	X	2990
81.0	81.6	gv-u	8	29	50	21	40.9	13.6	23	15	8	8	65	27	36	33	1<	1.6	X	2380
93.6	93.8	gv-u	3	38	43	19	56.1	12.4	24	13	11									
93.8		gs										26	49	25	32	0	18>	1.3	1	2090
98.4	99.0	gs-s	6	23	54	23	29.8	14.2	27	15	12									
103.5	104.0	gs-s	4	21	56	23	25.0	15.2	27	15	12									
108.5	109.0	gs-s	4	19	58	23	24.1	18.9	26	17	9	30	45	25	42	30	24>	1.2	4	3010
118.5	119.0	gs-s	8	22	55	23	27.3	16.3	26	16	10									
128.5	129.0	ps	0	19	54	27	20.1	19.9	31	16	15									
134.5	135.0	ps	0	10	63	27	19.8	21.8	29	17	12									
138.0	138.5	ps	0	10	61	29	17.3	21.4	29	17	12									
144.5	145.0	ps	0	12	62	26	19.6	21.5	28	16	12									
149.5	150.0	ps	0	6	67	27	20.1	22.3	28	16	12									
154.5	155.0	ps	0	5	66	29	19.3	22.6	28	17	11									
155.5	156.0	ps	0	2	65	33	11.5	23.8	32	17	15									

BOREHOLE # M-06
ELEVATION: 629.3 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
DEP TOP	DEP BOT	UNIT	TOT GVL %	SD %	<2mm ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
4.5	5.0	r	1	38	42	20	54.8	16.0	25	12	13	67	17	16	0	0	46>	0.7	9	3580
9.5	10.0	gv-mx	3	40	38	22	139.6	12.0	25	11	14									
14.5	15.0	gv-mo	7	59	27	14	89.8	19.6	18	12	6	22	65	13	0	20	10>	3.4	X	1800
16.1	16.6	gv-mo					38.9	16.4				26	59	15	47	49	18>	2.6	X	2480
24.5	25.0	gv-m	14	53	30	17	98.8	9.8	17	11	6	8	63	29	85	45	0	1.5	X	2600
29.5	30.0	gv-m	7	59	27	14	66.6	5.2	16	11	5	11	64	25	38	30	0	1.7	X	1820
34.0	34.5	gv-mz	2	94	3	3	3.1	13.3												
39.5	40.0	gv-m	3	45	34	21	90.4	8.7	21	11	10	10	59	31	67	40	3>	1.3	X	2630
44.5	45.0	gv-u	7	47	29	24	114.9	10.0	20	11	9									
49.5	50.0	gv-u	14	46	37	17	137.3	9.8	22	11	11									
54.5	55.0	gv-u	4	48	28	24	121.1	10.9	23	11	12	9	59	32	58	37	4>	1.2	X	2440
59.5	60.0	gv-u	5	45	31	24	94.6	11.1	21	12	9									
64.5	65.0	gv-u	9	43	35	22	102.3	11.0	24	12	12									
68.9	69.4	gv-u	6	41	36	23	77.0	10.7	26	13	13	12	55	33	47	25	7>	1.1	X	2400
74.5	75.0	gv-z	8	62	25	13	68.7	10.2												
79.5	80.0	gv-u	7	43	35	22	99.0	11.6	23	12	11	15	53	32	40	28	10>	1.1	X	2490
84.5	85.0	gv-u	7	43	36	21	95.1	10.3	21	12	9	11	56	33	40	30	6>	1.1	X	2040
89.5	90.0	gv-u	6	43	36	21	91.6	11.7	22	12	10	15	56	29	53	36	7>	1.3	X	2390
94.5	95.0	gv-u	13	53	33	14	84.5	13.3	18	13	5	17	55	28	37	35	11>	1.3	X	2040
97.0	97.7	gm-z	1	95	3	2	3.6	25.2												
98.0		gm-d										12	59	29	50	35	6>	1.4	X	2240
99.5	100.0	gm-z	9	50	33	17	106.4	14.3	20	12	8									
104.8	105.0	gm-z	17	64	26	10	97.1	9.3	15	14	1									
109.5	110.0	gm-s	3	15	73	12	15.9	14.7	22	19	3	22	54	24	45	0	16>	1.5	X	2330
114.5	115.0	gm-s	3	15	70	15	23.7	12.7	22	12	10	22	54	24	27	25	18>	1.5	2	1570
119.5	120.0	gs-s	3	21	52	27	27.1	17.4	31	14	17	22	47	31	35	34	27>	1.0	2	1710
123.8	124.3	gs-s	3	21	57	22	25.1	16.9	29	16	13									
129.5	130.0	gs-s	3	21	53	26	25.4	17.2	28	11	17	32	41	27	30	28	21>	1.1	1	2560
134.4	135.0	gs-s	2	21	52	27	25.0	16.1	28	16	12									
139.0	139.5	gs-s	2	19	65	16	33.9	19.5	24	17	7									
140.4	140.9	gs	6	26	37	37	24.4	18.3	38	13	25	31	46	23	30	20	10>	1.4	2	2480
144.0	144.5	gs-s	9	22	58	20	23.8	18.7	25	17	8									
149.5	150.0	gs-s	6	22	45	33	20.1	17.8	30	12	18									
154.5	155.0	ps	1	17	57	26	19.2	20.6	33	17	16									
159.0	159.5	ps	2	13	73	14	34.6	21.2	24	18	6	17	52	31	32	25	9>	1.1	X	1740
162.0	162.5	ps	0	15	62	23	25.8	21.3	27	18	9	18	55	27	25	18	20>	1.3	0	1700
168.4	169.1	ps	16	4	74	22	14.6	18.0	26	20	6									
169.1	170.0	ms-z	16	95	3	2	3.6	7.1												
175.0	175.5	ms-z	90	55	20	25	3.9	14.5												

BOREHOLE # M-07
ELEVATION: 626.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
DEP TOP	DEP BOT	UNIT	TOT GVL %	SD %	<2mm ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
4.5	5.0	p	0	10	59	31	14.1	18.5	41	16	25	75	15	10	0	0	54>	1.1	17	3980
9.5	10.0	b	1	56	19	25	147.3	18.9	31	11	20	84	10	6	0	0	54>	1.0	16	4340
14.5	15.0	gv-mo	28	54	23	23	312.3	12.4	22	11	11	20	62	18	40	70	11>	2.3	0	3080
19.5	20.0	gv-m	5	44	23	33	110.1	9.6	22	10	12	8	62	30	85	72	1<	1.4	X	3140
24.5	25.0	gv-u	5	42	35	23	81.2	9.5	22	11	11	22	43	35	65	52	10>	1.3	X	3480
29.5	30.0	gv-u	8	44	34	22	101.0	10.3	23	12	11	13	54	33	60	38	5>	1.1	X	3730
34.5	35.0	gv-u	6	42	34	24	88.5	10.1	22	11	11	14	55	31	60	40	10>	1.2	X	3180
39.5		gv-u										12	56	32	53	40	10>	1.2	X	2870
39.5	40.0	gv-u	5	43	34	23	91.5	9.7	24	12	12	14	55	31	70	42	10>	1.2	X	3760
44.5	45.0	gv-u	8	42	37	21	85.2	10.0	24	12	12	11	56	33	55	25	6>	1.1	X	3080
49.5	50.0	gv-u	7	41	34	25	89.5	10.1	24	12	12	9	57	34	60	35	9>	1.1	X	3490
54.5	55.0	gv-u	6	43	35	22	93.2	10.5	23	12	11	14	56	30	66	30	9>	1.2	X	3590
59.5	60.0	gv-u	12	43	37	20	108.2	12.7	23	11	12	17	52	31	52	40	13>	1.1	X	3150
64.5	65.0	gv-u	7	42	36	22	94.8	11.0	23	12	11	19	53	28	50	37	13>	1.3	X	3770
69.0	69.5	gv-u	9	47	36	17	116.6	9.6	22	11	11	22	54	24	62	50	12>	1.4	X	4290
72.0	72.5	gv-z	0	92	4	4	3.7	17.2				15	58	27	40	30	10>	1.4	X	1970
72.7		gv-m										12	62	26	50	48	0	1.6	X	3460
79.2	79.7	gv-m	8	32	52	16	42.8	13.0	21	14	7									
84.5	85.0	gv-u	10	40	40	20	86.8	12.4	22	12	10	13	57	30	45	45	7>	1.3	X	2680
89.5		gv-u										13	59	28	40	40	7>	1.4	X	2800
89.5	90.0	gv-u	8	45	38	17	96.4	10.4	20	12	8	13	59	28	40	40	7>	1.4	X	2880
94.5	95.0	gm-z	23	90	6	4	5.2	16.0				14	58	28	25	25	6>	1.4	X	930
114.3	114.8	gm-s	0	5	74	21	18.4	17.0	24	19	5	25	50	25	46	16	17>	1.3	3	1100
115.0	115.1	gm-z					2.1	6.0												
119.5	120.0	gm-s	0	6	73	21	18.5	32.8	46	32	14	24	46	30	0	0	16>	1.0	2	840
124.0		gs-s										64	17	19	0	0	45>	0.6	8	4300
124.5	125.0	gs-s	2	16	58	26	21.1	16.9	32	16	16	29	41	30	33	33	28>	0.9	2	2210
129.5	130.0	gs-s	2	15	63	22	20.8	20.5	31	18	13	26	46	28	28	0	25>	1.1	0	1810
129.5		gs										25	46	29	0	0	22>	1	2	1770
133.2	133.7	gs-s	0	4	70	26	13.2	21.1	34	18	16	20	54	26	37	32	17>	1.4	X	1910
139.5	140.0	gs-s	1	9	68	23	20.0	20.0	31	18	13	19	53	28	25	35	20>	1.2	X	1760
144.5	145.0	gs	8	30	46	24	37.9	18.5	26	14	12	9	53	38	25	15	12>	1.0	X	3360
149.3	149.8	gs	7	32	37	31	44.4	14.5	27	11	16	23	50	27	40	40	18>	1.3	0	3570
154.0	154.5	gs	6	32	38	30	41.1	14.9	27	12	15	22	51	27	48	22	17>	1.3	1	3500
159.5	160.0	gs-s	7	24	46	30	24.6	18.0	31	14	17	12	43	45	30	30	19>	0.6	X	2430
162.5	163.0	ms-s	2	12	42	46	8.4	20.9	46	14	32	45	26	29	0	0	33>	0.6	7	3070
167.0	167.5	ms-z	2	77	14	9	29.1	17.9				20	48	32	0	0	24>	1.0	X	2450
168.5	169.0	Pb	1	35	50	15	28.8	10.7	23	21	2	1	54	45	20	0	10<	0.8	X	5730

BOREHOLE # M-08
ELEVATION: 629.6 ft

SAMPLE IDENTIFICATION | PARTICLE SIZE DISTRIBUTION | ENGINEERING DATA | MINERALOGY OF THE <2um FRACTION

DEP TOP	DEP BOT	UNIT	TOT GVL %	SD %	<2mm ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
4.5	5.0	r	3	28	42	30	28.6	15.9	35	13	22	75	15	10	0	0	56>	1.0	3	4380
9.5	10.0	b	4	37	30	33	56.4	19.2	41	12	29									
12.6	13.0	pe	0	93	3	4	3.5	17.8												
14.5	15.0	gv-mo	4	45	31	24	96.6	7.7	22	11	11	9	71	20	48	46	5>	2.4	0	2120
19.5	20.0	gv-m	13	49	34	17	127.6	6.5	18	10	8	9	64	26	55	47	0	1.6	X	2140
24.5	25.0	gv-m	23	47	31	22	202.2	6.8	21	11	10	9	61	30	74	47	2>	1.3	0	2310
29.5	30.0	gv-u	4	45	32	23	101.3	8.2	22	11	11	10	61	29	50	35	3>	1.4	X	2110
34.5	35.0	gv-u	5	46	33	21	107.0	7.4	21	11	10	7	64	29	56	40	0	1.5	X	2570
39.5	40.0	gv-u	7	45	33	22	116.7	7.2	21	11	10									
42.8	43.3	gv-z	1	60	32	8	16.7	11.3												
49.5	50.0	gv-u	13	45	34	21	126.4	7.3	23	11	12									
54.5	55.0	gv-u	6	44	34	22	89.9	10.6	23	12	11									
59.5	60.0	gv-u	9	44	36	20	109.1	10.0	21	11	10									
64.5	65.0	gv-u	7	43	35	22	93.7	8.9	22	12	10	13	56	31	38	25	7>	1.2	X	1930
69.5	70.0	gv-u	5	44	36	20	83.2	7.9	21	12	9	12	55	33	42	20	10>	1.1	X	1690
70.8	71.2	gv-u	5	43	38	19	72.8	8.4	22	12	10	15	57	28	35	28	6>	1.4	X	1720
77.0	77.5	gv-u	4	37	42	21	53.2	10.6	23	13	10	14	67	19	25	20	2>	2.3	X	2210
80.0		gm-s										9	64	27	28	26	7<	1.6	X	1720
81.8	82.4	gm-d	5	40	39	21	66.7	5.2	21	12	9	8	69	23	20	31	7<	2.1	X	1680
88.9	89.4	gs	3	35	49	16	44.4	10.7	25	14	11	22	49	29	38	25	16>	1.1	0	2490
94.5	95.0	gs	5	32	45	23	40.1	12.9	27	13	14									
99.5	100.0	gs	4	34	43	23	47.5	13.6	26	13	13									
104.5	105.0	gs-s	3	25	51	24	35.3	13.9	30	14	16									
109.5	110.0	gs-s	3	22	53	25	25.3	14.8	29	14	15									
113.8	114.3	gs-s	11	25	50	25	35.9	14.7	29	14	15									
118.3	118.8	gs-s	2	22	54	24	24.8	15.8	30	15	15									
124.5	125.0	gs-s	6	21	57	22	27.4	19.7	29	16	13	37	31	32	40	40	29>	0.9	1	2175
128.8	129.2	gs-s	3	22	57	21	28.1	18.0	30	16	14									
131.0	131.5	gs-s	2	20	53	27	22.0	16.0	31	17	14									
138.3	138.8	gs-s	2	20	56	24	28.4	17.5	29	17	12									
144.5	145.0	ms-z	17	71	22	7	53.9	11.7												

BOREHOLE # M-09
ELEVATION: 628.8 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
4.5	5.0	r	1	26	41	33	19.1	13.9	38	12	26									
9.5	10.0	b	1	38	29	33	47.2	18.8	40	11	29	61	24	15	0	0	36>	1.1	1	1480
14.5	15.0	gv-mo	2	63	23	14	177.1	16.7	23	12	11	18	71	11	0	0	8>	4.4	3	1310
19.5	20.0	gv-mo	2	58	29	13	97.5	14.0	15	12	3	9	70	21	40	40	8>	2.2	X	1680
24.5	25.0	gv-m	8	58	26	16	191.7	6.8	18	11	7	8	66	26	60	40	4>	1.7	X	1940
29.5	30.0	gv-m	10	49	32	19	132.3	6.4	18	11	7	8	63	29	46	21	1<	1.5	X	2080
34.5	35.0	gv-m	4	47	30	23	122.5	10.2	22	11	11									
39.5	40.0	gv-m	4	46	31	23	104.2	7.6	22	11	11	11	57	32	56	45	5>	1.2	X	2280
44.5	45.0	gv-u	5	45	34	21	95.9	8.9	22	12	10									
49.0	49.5	gv-u	5	46	30	24	119.2	10.2	23	12	11									
59.5	60.0	gv-u	7	48	28	24	120.4	9.5	22	12	10									
64.5	65.0	gv-u	5	44	35	21	96.2	8.0	22	12	10									
69.2	69.7	gv-u	6	45	35	20	112.0	9.1	21	12	9	12	56	32	35	17	10>	1.2	X	1650
74.5	75.0	gv-u	15	47	35	18	150.4	9.7	20	12	8	15	53	32	56	35	9>	1.1	X	2170
79.5	80.0	gv-u	5	39	35	26	74.2	10.4	24	12	12	5	69	26	45	41	6<	1.2	X	2050
84.5	85.0	gv-u	2	35	49	16	42.6	10.1	23	14	9	17	50	33	40	32	11>	1	X	2300
89.5	90.0	gv-u	3	37	43	20	53.0	9.9	23	12	11	21	50	29	37	25	15>	1.1	2	1990
94.5	95.0	gm-z	22	63	27	10	176.5	11.6												
99.5	100.0	gs-s	2	25	54	21	28.3	13.0	26	14	12									
104.5	104.5	gs-s	3	24	53	23	30.2	12.2	28	14	14									
109.5	110.0	gs	4	26	51	23	30.2	15.6	30	15	15									
113.0	113.5	gs	6	26	53	21	31.2	15.7	28	16	12	26	40	34	20	28	21>	0.8	1	2310
115.5	116.0	ms-d	1	31	48	21	41.9	14.6	24	15	9	23	34	43	20	18	25>	0.5	2	1740
121.5	122.0	Pb						11.0												

BOREHOLE # M-10

ELEVATION: 626.5 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
4.5	5.0	r	1	15	45	40	13.5	20.4	46	14	32	82	11	7	0	0	50>	1.1	26	6010
9.5	10.0	b	1	34	28	38	34.0	20.3	41	12	29	72	19	9	0	0	57>	1.4	10	3680
14.0	14.5	gv-mo	4	50	27	23	129.3	13.2	23	12	11	13	71	16	22	35	7>	3.0	X	1650
19.5	20.0	gv-mo	5	46	31	23	119.9	10.1	21	10	11	11	67	22	55	47	5>	2.0	X	2700
24.5	25.0	gv-m	5	60	27	13	62.0	7.9	14	11	3	7	61	32	65	42	1<	1.3	X	2400
29.5	30.0	gv-u	5	45	32	23	99.5	7.6	23	11	12	11	58	31	48	30	8>	1.3	X	2680
34.5	35.0	gv-u	6	45	33	22	95.2	9.3	22	11	11									
39.5	40.0	gv-u	7	44	34	22	105.5	9.6	23	12	11									
40.8	41.3	gv-u	8	46	35	19	118.6	10.2	23	11	12	11	56	33	52	35	5>	1.1	X	2530
54.5	55.0	gv-z	1	64	25	11	42.2	15.6												
57.2	57.7	gv-z	0	91	4	5	3.3	21.8												
64.5	65.0	gv-u	7	44	34	22	101.6	9.9	22	12	10	12	54	34	55	27	6>	1.1	X	2530
69.5	70.0	gv-u	8	45	34	21	100.7	10.7	23	12	11									
74.5	75.0	gv-u	7	45	35	20	106.7	7.9	21	12	9									
79.5	80.0	gv-u	7	45	36	19	102.4	8.7	22	12	10									
82.0	82.5	gv-u	8	45	35	20	106.6	9.2	22	12	10	14	54	32	48	33	9>	1.1	X	2220
88.5	89.0	gv-u	7	45	37	18	108.2	9.4	21	11	10	13	54	33	62	41	7>	1.1	X	2270
94.5	95.0	gv-u	10	47	39	14	124.6	10.7	18	13	5	18	56	26	42	28	11>	1.5	X	2660
99.5	100.0	gm-z	37	75	18	7	113.7	11.5	16	13	3									
104.5	105.0	gm-z	61	92	5	3	13.2	7.7												
106.0		gs										15	53	32	48	20	12>	1.1	0	2656
108.5	109.0	gs-s	3	21	57	22	25.7	15.3	28	15	13	37	37	26	20	15	26>	1.2	3	1670
114.5	115.0	gs-s	2	22	55	23	27.8	16.6	26	15	11									
119.5	120.0	gs-s	3	21	56	23	28.1	16.5	29	15	14									
124.5	125.0	gs-s	2	20	59	21	23.3	17.7	29	15	14									
129.5	130.0	gs-s	1	18	58	24	21.4	18.1	29	16	13									
134.0	134.5	gs-s	4	15	64	21	25.0	21.6	26	18	8									
136.5	137.0	ps	0	8	75	17	18.5	19.9	27	18	9	19	53	28	25	26	15>	1.3	2	1980
142.0	142.5	ps	0	5	80	15	19.5	21.0	25	22	3									
146.0	146.5	ps	0	3	64	33	11.1	20.3	32	17	15	17	57	26	33	18	13>	1.4	X	1910
148.5	149.0	ps	0	11	64	25	14.2	22.2	29	18	11	28	43	29	0	0	23>	1.0	X	900
149.1		ms-z										32	40	28	32	25	30>	1.0	5	1570

BOREHOLE #   M-11
ELEVATION: 603.1 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP	DEP	UNIT	GVL	SD	ST	CL	Cu	W%	LL	PL	PI	EXP	ILL	C-K	CAL	DOL	VERM	DI	HSI	INT
TOP	BOT		%	%	%	%						%	%	%			IND			CPS
4.5	5.0	pe	15	82	5	13	255.0	4.8												
9.5	10.0	gv-mo	1	43	39	18	129.7	13.2	18	12	6	11	71	18	35	32	5>	2.7	X	1480
14.5	15.0	gv-m	6	47	30	23	128.0	9.9	20	11	9	10	65	25	58	45	2>	1.7	X	2500
19.5	20.0	gv-u	7	45	31	24	125.7	9.3	21	11	10	9	67	24	65	40	1>	1.8	X	2630
24.5	25.0	gv-u	9	47	29	24	126.7	9.3	20	11	9									
29.5	30.0	gv-u	6	48	29	23	119.4	8.6	20	11	9									
34.5	35.0	gv-u	7	45	34	21	113.6	9.2	19	11	8									
37.0	37.5	gv-u	5	50	31	19	132.5	10.0	23	11	12									
44.5	45.0	gv-u	5	43	36	21	88.0	10.4	22	12	10									
49.5	50.0	gv-u	7	42	38	20	82.5	12.2	22	13	9									
54.0	54.5	gv-u	7	42	42	16	66.8	11.9	21	13	8	16	54	30	45	30	10>	1.2	X	2720
59.5	60.0	gv-u	8	42	44	14	38.9	10.3	18	15	3									
60.0	60.5	gv-z	0	83	12	5	16.3	15.1												
65.0		gv-u										6	67	27	35	28	6<	1.7	1	2460
69.5	70.0	gv-u	8	35	45	20	57.5	10.1	22	13	9	10	63	27	40	35	3>	1.5	3	1970
74.5	75.0	gv-u	4	40	43	17	63.1	8.7	20	12	8	14	61	25	52	54	10>	1.6	X	3560
79.5	80.0	gm-s	1	18	59	23	19.9	18.8	31	16	15	28	40	32	0	0	28>	0.8	3	2490
84.5	85.0	gs-s	0	19	55	26	30.0	18.6	31	15	16	25	46	29	28	20	24>	1.1	X	1810
89.5	90.0	gs-s	2	22	26	52	9.7	26.0	61	17	44									
94.5	95.0	gs-s	1	15	55	30	16.3	24.3	31	16	15	30	40	30	27	27	27>	0.9	3	2100
95.5	96.0	gs-s	0	2	79	19	9.8	22.5	28	23	5	15	53	32	38	32	16>	1.1	X	1750
104.5	105.0	gm-d	3	35	42	23	45.1	12.5	23	13	10	3	62	35	60	15	2<	1.2	X	3280
109.5	110.0	gs	6	39	40	21	59.0	12.2	22	13	9	5	57	38	40	35	0	1.0	X	2660
111.3	111.8	gs	0	42	50	8	11.4	15.3	18	17	1	9	57	34	42	15	9>	1.1	X	1790
119.5	120.0	gs-s	5	16	39	45	12.7	15.9	30	14	16	14	52	34	35	22	12>	1.0	X	2150
124.5	125.0	gs	2	27	41	32	31.1	15.1	31	14	17	14	50	36	30	30	20>	0.9	X	2430
129.5	130.0	Pb-x	0	31	39	30	27.3	19.4	46	14	32	47	21	32	0	0	40>	0.4	4	2280
133.7	134.2	Pb	5	12	41	47	9.5	21.7	46	14	32									
134.5	135.0	Pb	0	35	49	16	32.3	10.4	25	19	6									

BOREHOLE # M-12
ELEVATION: 577 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.9		c										42	41	17	0	0	29>	1.6	2	1630
4.5	5.0	c	0	22	54	24	25.6	22.9	35	18	17	31	52	17	0	0	16>	2.0	5	810
7.0		c										43	43	14	0	0	26>	2.0	5	1270
8.5	9.0	c	0	73	19	8	26.9	23.6												
10.0	10.5	c	0	95	3	2	2.9	24.4												
17.5	18.0	c	53	94	3	3	17.2	16.5												
22.3	22.8	c	50	95	3	2	5.6	14.3												
29.5	30.0	c	84	84	10	6	47.7	8.5												

BOREHOLE # M-13
ELEVATION: 580.8 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
3.5	4.0	c	0	14	65	21	18.7	25.6	32	19	13	31	48	21	0	0	20>	1.5	5	750
6.2	6.7	c	4	91	6	3	5.4	17.7				45	39	16	0	0	33>	1.6	6	1770
14.5	18.0	gv-u	5	46	33	21	55.8	9.8	22	13	9	15	54	31	52	35	6>	1.2	X	3050
15.5	16.0	gv-u	3	46	33	21	44.2	12.6	23	12	11	27	48	25	38	32	19>	1.3	3	2860

BOREHOLE # M-14
ELEVATION: 638.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
3.5	4.0	r	0	34	42	24	25.3	8.8	26	18	8	47	32	21	0	0	38>	1.0	3	750
7.0	7.5	pe	0	63	14	23	145.8	11.1	34	15	19	28	49	23	0	0	28>	1.4	0	1410
12.0	12.5	gv-mo	5	49	28	23	128.2	7.4	24	15	9	18	64	18	75	50	12>	2.3	X	2530
14.5		gv-m										20	52	28	40	29	13>	1.3	2	1940
16.8	17.1	gv-mz	1	90	6	4	4.1	16.4												
21.4	21.8	gv-m	4	44	33	23	88.4	7.3	22	11	11	13	57	30	53	35	7>	1.3	X	2650
27.5	28.0	gv-u	3	44	29	27	90.5	6.2	23	11	12									
32.7	33.2	gv-u	3	44	33	23	89.7	10.9	24	11	13									
39.5	40.0	gv-u	7	44	34	22	98.9	10.0	22	11	11									
44.5	45.0	gv-u	7	45	33	22	106.6	11.3	21	11	10									
49.5	50.0	gv-u	34	52	28	20	477.5	10.1	22	11	11									
54.5	55.0	gv-u	8	45	32	23	102.3	11.5	23	12	11									
59.5	60.0	gv-u	5	43	35	22	88.8	10.1	22	12	10									
64.5	65.0	gv-u	10	45	32	23	113.5	11.7	22	12	10									
69.5	70.0	gv-u	13	44	31	25	109.4	13.1	22	11	11									
74.5	75.0	gv-u	15	47	31	22	143.7	10.9	21	11	10									
79.5	80.0	gv-u	7	45	33	22	103.7	10.4	20	11	9	13	59	28	42	28	6>	1.4	X	2240
84.5	85.0	gv-u	8	45	35	20	108.5	9.1	21	11	10	15	56	29	40	34	7>	1.3	X	2350
89.5	90.0	gv-u	4	38	39	23	64.4	10.5	22	12	10	19	56	25	45	51	10>	1.5	1	2420
94.5		gv-u	8	35	49	16	53.5	12.6	22	13	9									
94.8		gs										31	46	23	28	29	23>	1.3	0	2230
99.5	100.0	gs	6	32	47	21	46.2	11.9	25	12	13	33	43	24	40	30	22>	1.2	1	2690
104.5	105.0	gs	3	27	50	23	33.7	13.8	26	13	13	26	48	26	40	23	17>	1.2	3	2640
109.1	109.6	gs	3	27	50	23	33.6	11.9	25	15	10									
114.5	115.0	gs	3	27	50	23	31.8	11.4	26	14	12									
119.0	119.5	gs-s	5	25	52	23	32.0	13.8	27	13	14									
123.4	123.9	gs	0	43	46	11	22.0	11.1												
126.5	127.0	gs-s	3	25	59	16	32.9	14.0	23	17	6									
130.5	130.7	gs	0	33	56	11	18.7	16.3												
134.5	135.0	gs-s	4	22	53	25	26.5	15.7	27	14	13									
139.5	140.0	gs-s	5	23	52	25	30.2	14.3	28	14	14									
144.5	145.0	gs-s	5	22	52	26	24.9	15.1	27	15	12	20	48	32	32	26	20>	1.0	X	2220
149.5	150.0	ms-d	2	33	44	23	38.7	13.4	22	12	10	28	36	36	20	20	27>	0.7	2	1600
154.0	154.4	ms-d	0	49	23	28	84.1	15.3	26	13	13									
157.0	157.4	ms-d	0	28	46	26	37.9	17.4	26	14	12									
159.5	160.0	ms-z	26	77	15	8	55.5	17.3												
161.3		ms-d										30	36	34	0	0	14>	0.7	5	830
162.0	162.5	Pb	37	81	14	5	48.1	11.3												

BOREHOLE # M-15
ELEVATION: 628.5 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
DEP TOP	DEP BOT	UNIT	TOT GVL %	SD %	<2mm ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
15.0	15.5	b	5	64	17	19	185.0	19.9	25	10	15	51	30	19	0	0	43>	1.1	2	3310
18.1	18.6	pe	3	80	13	7	33.4	25.1												
24.8	25.3	gv-m	3	49	31	20	121.3	9.2	20	11	9	11	61	28	60	40	4>	1.5	X	2150
29.8	30.3	gv-m	4	44	36	20	85.4	10.1	18	12	6									
32.1	32.6	gv-m	7	43	30	27	104.9	9.0	21	8	13	7	65	28	33	22	0	1.5	X	2050
35.3	36.0	gv-mz	5	90	7	3	4.5	20.2												
36.1	36.3	gv-m	4	47	30	23	115.3	9.4	20	11	9	12	62	26	59	40	6>	1.6	X	1690
37.8	38.3	gv-mz	3	96	2	2	2.5	20.0												
40.3	40.8	gv-mz	8	87	8	5	7.6													
43.3	43.8	gv-u	5	44	33	23	97.0	8.4	21	11	10	11	59	30	70	42	2>	1.3	X	2710

BOREHOLE # M-15A
ELEVATION: 628.7 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
9.5	10.0	b	0	32	38	30	34.8	40.9	37	12	25	65	20	15	0	0	45>	0.9	9	2140
16.5	16.9	gv-m	1	34	51	15	32.1	10.4	17	14	3	7	63	30	75	47	3>	1.4	X	2290
23.3	23.7	gv-m	7	51	31	18	143.7	8.2	18	10	8	8	62	30	43	30	5>	1.4	X	2020
27.6	28.1	gv-m	3	54	30	16	139.2	8.0	17	10	7	7	61	32	68	46	1>	1.3	X	2460
30.6	31.0	gv-u	3	42	34	24	79.0	7.5	21	11	10	8	63	29	70	45	1>	1.4	X	2010
36.3	36.7	gv-u	5	45	31	24	107.2	7.6	20	11	9									
41.6	42.0	gv-u	4	46	31	23	100.7	8.9	22	11	11									
49.7	50.1	gv-u	7	44	33	23	105.0	10.3	22	12	10									
54.1	54.6	gv-u	5	43	34	23	89.7	9.9	22	12	10									
58.7	59.1	gv-u	3	43	32	25	85.8	9.7	22	12	10									
63.2	63.7	gv-u	8	44	32	24	110.2	10.2	21	11	10									
67.6	68.0	gv-u	11	44	34	22	123.5	9.3	22	12	10									
71.9	72.3	gv-u	11	45	33	22	134.9	10.8	21	12	9									
76.2	76.6	gv-u	8	50	30	20	161.1	10.0	21	11	10	12	58	30	33	25	12>	1.2	X	2300
80.5	81.0	gv-u	6	45	34	21	97.9	9.6	20	12	8	17	53	30	55	35	15>	1.1	2	2220
84.4	84.9	gm-z	11	65	25	10	93.7	9.0												
88.8	89.2	gs	3	32	47	21	44.9	11.4	22	13	9	25	50	25	37	30	17>	1.3	2	3030
92.8	93.2	gs	3	30	48	22	40.7	11.5	23	13	10	23	52	25	38	30	17>	1.4	2	2430
97.4	97.9	gs	4	30	47	23	39.2	11.1	24	14	10									
101.8	102.2	gs-s	13	25	54	21	45.6	11.0	24	14	10									
106.1	106.5	gs-s	1	21	60	19	33.4	12.4	24	15	9									
110.4	110.9	gs-s	1	18	59	23	28.1	18.5	26	17	9									
114.3	114.8	gs-s	1	21	60	19	29.9	14.9	26	16	10									
119.1	119.5	gs-s	1	20	57	23	25.5	16.7	27	15	12									
123.4	123.8	gs-s	2	20	61	19	23.8	17.0	26	16	10									
129.5	129.9	gs-s	1	17	59	24	17.8	17.5	29	17	12	30	40	30	25	28	25>	0.9	1	1620
133.8	134.2	gs	1	26	38	36	20.2	17.4	33	13	20	20	50	30	33	32	17>	1.1	3	2290

BOREHOLE # M-15B
ELEVATION: 628.6 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
14.5	15.0	pe	5	80	9	11	76.8	27.0												
19.5	20.0	gv-m	23	47	35	18	240.2	19.4	19	12	7	9	60	31	54	40	2>	1.3	X	2410
20.0	20.5	gv-m	18	52	33	15	202.3	11.2												
25.8	26.3	gv-u	6	57	29	14	72.7	6.5				12	62	26	35	20	5>	1.6	X	1640
26.3	26.7	gv-z	2	96	3	1	4.0	24.4												
26.7	27.2	gv-z	8	56	35	9	27.8	11.7												
32.7	33.2	gv-u	6	46	31	23	118.7	7.2	20	11	9	9	62	29	57	46	1<	1.4	X	2320
37.6	38.1	gv-u	6	45	31	24	119.1	6.5	21	11	10									
40.3	40.8	gv-u	7	44	27	29	115.5	7.7	21	11	10									
45.5	46.0	gv-u	7	47	29	24	134.6	7.3	19	11	8									
49.5	50.0	gv-u	8	44	32	24	113.5	6.8	19	11	8									

BOREHOLE # M-101
ELEVATION: 628.7 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP	DEP	UNIT	GVL	SD	ST	CL	Cu	W%	LL	PL	PI	EXP	ILL	C-K	CAL	DOL	VERM	DI	HSI	INT
TOP	BOT		%	%	%	%						%	%	%			IND			CPS
4.0	4.5	r	3	6	48	46	10.4	28.7	54	17	37									
9.5	10.0	b	3	31	25	44	18.0	25.7	47	12	35									
14.5	15.0	gv-m	8	48	23	29	146.5	7.3	22	10	12	13	62	25	55	45	7>	1.6	X	1980
18.8	19.3	gv-mz	9	82	13	5	8.8	10.0				9	63	28	35	25	3>	1.5	X	1710
24.5	25.0	gv-m	8	55	26	19	86.7	6.0	15	11	4	7	68	25	47	38	2<	1.4	X	2450
29.5	30.0	gv-m	4	44	28	28	92.0	8.2	18	11	7									
34.5	35.0	gv-u	5	45	28	27	114.7	8.1	20	11	9									
39.0	39.5	gv-u	4	43	31	26	90.8	11.0	21	11	10									
44.5	45.0	gv-u	7	43	30	27	103.4	10.9	22	11	11									
49.2	49.7	gv-u	6	45	31	24	111.9	11.0	20	11	9									
54.0	54.5	gv-u	9	44	29	27	109.3	10.7	22	11	11									
59.5	60.0	gv-u	11	43	31	26	127.9	10.7	22	12	10									
64.5	65.5	gv-u	6	42	32	26	91.3	10.7	22	12	10									
69.1	69.6	gv-u	7	43	30	27	110.7	9.5	22	12	10									
74.3	74.8	gv-u	6	42	33	25	95.0	9.3	21	12	9									
79.5	80.0	gv-u	9	43	32	25	110.1	10.3	22	12	10									
83.5		gv-u										10	58	32	34	20	5>	1.2	X	1640
84.0	84.5	gv-u	11	42	33	25	115.8	10.0	22	11	11									
89.3	89.8	gv-u	13	45	32	23	138.1	9.4	21	12	9									
93.9	94.4	gv-u	9	44	30	26	121.9	9.0	21	12	9									
99.8		gv-u										8	60	32	45	33	2>	1.3	X	2160
99.8		gv-u										8	59	33	62	50	4>	1.1	X	3240
101.2	101.7	gv-u	7	44	34	22	99.9	8.2	20	12	8									
103.0	103.5	gv-z	19	68	21	11	69.3	7.3												
104.3	104.8	gv-u	6	49	34	17	111.2	8.3	19	12	7	14	60	26	35	22	5>	1.5	X	1350
108.1	108.6	gv-u	5	48	34	18	130.5	8.9	19	12	7									
111.5		gv-u										16	58	26	22	19	5>	1.5	X	2060
113.6	114.1	gv-u	14	41	41	18	114.5	10.0												
119.0	119.5	gv-u	7	35	44	21	63.5	14.3	26	13	13									
124.0	124.5	gs-s	4	17	58	25	22.0	17.8	27	16	11	29	44	27	43	27	24>	1.1	1	1990
129.5	130.0	gs-s	4	16	60	24	22.0	19.6	28	15	13									
130.5	131.0	gs-s	3	19	59	22	24.3	15.5	26	16	10	21	53	26	30	20	17>	1.3	X	2200
132.0	132.5	gs-z	25	93	4	3	3.2	7.7												
138.5		gs-s										27	48	25	40	32	19>	1.3	0	3000
144.3	144.8	gs-s	4	16	65	19	25.9	14.4	22	18	4	21	53	26	38	38	13>	1.4	2	2900
149.5	150.0	gs	9	33	40	27	27.9	16.1	25	13	12	34	39	27	40	40	26>	1.0	2	2000
152.5	153.0	gs-s	8	13	63	24	22.0	18.3	26	15	11	24	46	30	31	0	22>	1.0	2	1940
153.9		ps										13	56	31	30	25	9>	1.2	X	2470

BOREHOLE # M-102
ELEVATION: 622.1 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.3		p										41	44	15	0	0	20>	2.0	1	610
2.3		p										48	33	19	0	0	30>	1.1	5	1640
3.3		r										73	18	9	0	0	47>	1.3	5	2820
4.0	4.5	r	4	22	42	36	16.8	20.2	46	12	34	76	15	9	0	0	56>	1.1	12	4600
9.0	9.5	b	5	38	31	31	73.3	18.0	32	12	20	82	14	4	0	0	46>	1.9	18	4600
14.0	14.5	gv-mo	5	48	33	19	86.2	6.8	17	11	6									
14.2		gv-mo										32	55	13	32	50	17>	2.8	6	2410
14.5		gv-m										13	57	30	50	53	9>	1.3	X	2460
	18.0	gv-m	11	14	56	30		7.2												
19.0	19.5	gv-m	8	45	47	8	25.8	8.0	17	10	7	11	62	27	64	42	2>	1.5	1	2130
24.0	24.5	gv-u	5	46	37	17	70.8	7.6												
29.0	29.5	gv-u	10	42	32	26	120.1	8.1	19	10	9	11	61	28	72	33	1>	1.4	X	2400
34.0	34.5	gv-u	8	41	32	27	103.0	8.4	22	11	11									
39.0	39.5	gv-u	10	40	32	28	100.8	10.0	23	12	11	11	58	31	58	30	7>	1.2	X	2490
44.0	44.5	gv-u	9	38	40	22	86.8	9.7	21	12	9									
49.0	49.5	gv-u	11	39	33	28	102.4	8.9	22	11	11	12	57	31	53	35	6>	1.2	X	2540
54.0	54.5	gv-u	11	45	28	27	143.1	8.0	19	11	8									
56.0	56.5	gv-u	10	47	28	25	132.5	7.9	20	11	9									
58.5	59.0	gv-u	25	71	19	11	84.7	9.3				9	57	34	60	50	4>	1.1	X	2420
63.9	64.4	gv-u	11	44	29	27	126.6	9.4	22	12	10									
66.5	67.0	gv-u	7	41	32	27	95.6	8.4	20	12	8									
69.5		gv-u										16	55	29	30	15	10>	1.3	X	2380
70.4	71.4	gv-u	6	41	33	26		8.6												
79.0	79.5	gv-u	10	41	40	19	92.9	9.4	18	13	5	17	56	27	31	28	8>	1.3	X	2540
82.4		gv-u										9	67	24	38	33	2<	1.9	X	2640
84.0	84.5	gs	12	30	45	25	56.3	10.1	23	14	9									
86.0		gs										29	46	25	25	25	20>	1.3	0	2210
89.0	89.5	gs-s	15	22	53	25	44.9	13.9	23	15	8	26	51	23	30	25	18>	1.5	X	2080
93.0	93.5	gs	10	31	48	21	54.2	10.2	21	14	7									
98.0	98.5	gs-s	4	20	56	24	26.6	14.0	26	16	10	28	47	25	20	20	22>	1.3	1	2270
103.5	104.0	gs-s	5	4	83	13	13.1	18.4	24	24	0	28	48	24	21	20	19>	1.4	2	1860
109.0	109.5	gs-s	10	18	59	23	35.1	15.1	25	17	8	29	48	23	29	15	19>	1.4	1	1990
113.5	114.0	gs-s	6	18	61	21	25.5	15.3	26	16	10									
115.5	116.0	gs-s	5	18	59	23	27.0	15.8	25	16	9	28	46	26	30	23	23>	1.2	2	2360
119.0	119.5	gs-z	53	70	23	7	104.8	4.4												

BOREHOLE # M-102

ELEVATION: 622.1 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
120.5	121.0	gs-s	10	21	62	17	24.1	17.9	21	18	3									
123.5	124.0	gs-s	2	19	61	20	24.0	16.4	26	18	8									
128.8	129.3	gs-s	8	14	68	18	27.2	17.6	26	19	7									
130.6		ps										19	51	30	20	25	18>	1.1	X	2480
134.0	134.5	ps	5	22	66	12	22.1	12.6				14	56	30	0	0	13>	1.2	X	1190
138.5	139.0	ps	1	2	71	27	18.1	23.1	27	19	8									
143.5	144.0	ps	1	23	67	10	11.5	22.4				16	54	30	27	28	14>	1.2	X	2070
146.0	146.5	ps	15	2	78	20	26.9	24.1	27	20	7									
151.5	152.0	ps	16	1	59	40	15.6	24.4	33	18	15	19	55	26	27	27	15>	1.4	X	1980
158.3	158.8	ms-z	1	73	20	7	9.2	20.2												
160.0	160.5	ms-z	5	71	24	5	17.3	21.2				20	54	26	0	0	15>	1.4	X	1170
165.9	166.4	ms-z	45	75	16	9	147.3	11.8				20	48	32	0	0	3>	1.0	X	560
171.0	171.5	ms-z	46	74	17	9	125.0	10.3												

BOREHOLE # M-103
ELEVATION: 629.4 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
DEP TOP	DEP BOT	UNIT	TOT GVL %	SD %	<2mm ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.1	1.5	p	3	15	54	31	15.4	25.3	31	20	11									
2.5	3.0	p	3	7	44	49	8.6	29.4	60	16	44									
4.1	4.5	r	6	14	46	40	12.9	23.0	41	15	26									
7.0	7.5	b	5	20	40	40	14.5	23.3	36	17	19									
10.5	11.0	b	6	36	26	38	69.5	22.6	42	11	31	39	45	16	0	0	35>	1.8	X	1480
16.5	17.0	gv-mz	19	77	17	6	36.1	15.0				18	53	29	25	15	8>	1.3	2	840
19.1	19.5	gv-m	12	47	30	23	161.6	8.6	19	10	9	9	65	26	55	40	0	1.7	X	2250
24.2	24.7	gv-m	12	51	27	22	298.6	9.7	19	10	9	8	66	26	50	30	1>	1.7	X	1910
25.0	25.5	gv-mz	12	83	11	6	38.4	15.8												
29.5	30.0	gv-m	14	47	30	23	148.4	9.9	21	11	10	12	57	31	35	25	9>	1.2	X	1850
33.9	34.4	gv-u	10	43	30	27	125.6	11.1	22	11	11	12	58	30	50	25	5>	1.2	X	2120
34.7	35.2	gv-u	7	42	31	27	95.4	10.5	22	11	11									
37.0	37.5	gv-u	4	44	31	25	107.2	10.0	22	12	10									
44.5	45.0	gv-u	5	42	32	26	113.9	10.3	22	11	11									
44.6		gv-u										13	56	31	35	15	7>	1.2	X	2690
48.5	49.0	gv-u	6	42	30	28	120.5	12.1	23	12	11									
59.5	60.0	gv-u	5	42	33	25	113.6	7.6	21	12	9									
63.5	64.0	gv-u	6	46	31	23	112.3	10.1	22	12	10	15	56	29	45	20	7>	1.3	X	2370
69.0	69.5	gv-u	14	42	31	27	137.5	9.3	21	11	10									
70.5	71.0	gv-u	9	43	34	23	106.0	9.3	20	11	9									
74.0	74.5	gv-u	9	55	22	23	202.4	9.7	20	12	8	13	56	31	53	32	10>	1.2	X	2430
79.0	79.5	gv-u	19	43	36	21	172.2	9.3	19	12	7	16	53	31	63	35	8>	1.1	X	2270
79.4		gv-u										16	56	28	40	25	8>	1.3	2	2510
84.4		gs										26	48	26	35	28	21>	1.2	2	2510
84.5	85.0	gs-s	17	23	48	29	38.5	14.0	26	13	13	34	42	24	40	30	25>	1.1	2	2870
89.5	90.0	gs-s	16	22	51	27	33.0	12.4	26	13	13	31	45	24	25	25	21>	1.2	X	1680
94.0	94.5	gs-s	4	20	56	24	33.5	13.6	26	14	12									
97.0	97.5	gs-s	12	19	56	25	37.1	15.7	27	15	12	32	39	29	0	0	21>	0.9	1	2460
100.0		gs-s										25	42	33	25	30	20>	0.8	0	2370
103.8	104.3	gs-s	3	20	53	27	24.7	14.9	26	15	11									
105.0	105.5	gs-s	9	20	51	29	30.6	16.8	27	15	12	24	53	23	45	30	18>	1.5	X	2910

BOREHOLE # M-104
ELEVATION: 623.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
0.5	1.0	p	1	12	59	29	16	23.4	32	18	14	48	31	21	0	0	34>	1.0	6	1450
2.0	2.5	p	1	7	48	45	10.2	30.1	49	16	33									
3.7		p										69	17	14	0	0	50>	0.8	11	2760
4.6		r										75	13	12	0	0	48>	0.7	8	2800
7.0	7.5	b	3	14	42	44	12.0	22.2	40	14	26									
8.1		b																		
8.6		b																		
9.3	9.8	b	3	24	35	41	19.7	21.2	41	12	29									
11.3	11.8	b	2	50	22	28	146.8	20.9	28	10	18	30	58	12	0	0	22>	3.2	2	3000
14.8		gv-mo										16	70	14	0	0	7>	3.3	X	1415
15.2		gv-m										17	63	20	13	35	8>	2.1	X	1620
17.0		gv-m										9	62	29	45	38	3>	1.4	X	2860
19.5	20.0	gv-m	7	52	19	29	102.3	8.8	21	11	10									
22.0		gv-m										13	60	27	60	35	5>	1.5	X	2525
22.0		gv-m										14	58	28	95	50	5>	1.4	X	3700
23.5	24.0	gv-m	5	52	20	28	90.8	7.7	21	11	10									
27.5	28.0	gv-m	7	51	25	24	86.2	8.7	21	11	10	17	55	28	50	30	10>	1.3	X	2740
30.0		gv-m										13	58	29	65	35	5>	1.3	X	2820
33.5	34.0	gv-m	9	42	32	26	103.0	9.2	22	11	11	15	55	30	46	30	7>	1.2	X	2550
38.9	40.0	gv-m	7	41	35	24	83.8	9.9	21	11	10	15	56	29	35	26	10>	1.3	X	2270
44.3	44.8	gv-m	9	40	34	26	90.3	4.1	23	12	11									
49.5	50.0	gv-u	9	42	34	24	102.8	9.3	20	12	8	14	55	31	52	30	6>	1.2	X	3250
52.0	52.5	gv-u	8	40	33	27	91.2	8.6	21	12	9									
54.0	54.5	gv-u	6	45	32	23	111.5	9.2	20	11	9									
59.5	60.0	gv-u	9	42	34	24	102.5	8.7	22	11	11	12	59	29	40	22	7>	1.4	X	2130
64.5	65.0	gv-u	7	40	35	25	96.5	9.7	21	12	9									
67.0	67.5	gv-u	6	40	40	20	82.8	9.6	21	13	8									
67.5	68.0	gv-u	8	39	40	21	82.3	9.9	20	12	8									
70.0		gv-u										18	59	23	32	27	3>	1.7	X	2440
73.5	74.0	gv-u	7	38	40	22	67.3	10.2	21	12	9									
75.0	75.5	gv-u	6	38	36	26	72.6	11.4	21	12	9									
77.5		gv-u										17	59	24	33	33	6>	1.7	X	2630
77.6		gv-u										8	67	25	60	59	4<	1.8	X	3970
82.5	83.0	gm-d	7	43	35	22	105.0	9.1	19	12	7	5	72	23	45	37	12<	2.1	X	2960
84.5	85.0	gs	8	29	47	24	47.6	10.8	23	13	10	30	45	25	43	42	20>	1.2	0	2160
89.4	89.9	gs	7	34	45	21	56.0	11.0	23	13	10	24	52	24	20	18	15>	1.4	X	2800
93.5	94.0	gs-s	5	25	56	19	33.6	11.5	22	15	7									
96.0	96.5	gs-s	4	24	54	22	33.4	12.9	22	16	6									
99.5	100.0	gs-s	4	19	58	23	28.2	14.7	25	15	10	31	44	25	34	23	22>	1.2	2	2430

BOREHOLE # M-104
ELEVATION: 623.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
104.1	104.6	gs-s	4	18	59	23	26.3	16.6	26	15	11									
109.3	110.5	gs-s	4	18	59	23		16.6				35	42	23	30	43	26>	1.2	0	1720
114.5	115.0	gs-s	3	17	57	26	23.8	16.3	27	14	13									
118.0	118.5	gs-s	3	17	58	25	27.6	16.5	26	15	11									
121.2		gs-s										27	50	23	0	0	18>	1.5	X	1730
123.5	124.0	gs-s	3	13	65	22	21.6	18.4	26	19	7									
126.5	127.0	gs-s	2	14	60	26	21.8	18.2	27	16	11	25	46	29	17	12	20>	1.0	X	1780
127.0	127.5	gs-s	3	16	62	22	24.6	18.9	26	17	9									
130.3	130.8	gs-s	1	15	55	30	22.0	19.7	29	16	13	29	42	29	0	0	24>	1.0	3	2015
132.5		ps										19	53	28	32	25	16>	1.3	X	1700
134.2	134.7	ps	1	1	86	13	14.8	29.9	26	25	1									
137.0	137.5	ps	2	2	74	24	19.9	23.4	27	21	6									
140.0		ps										23	52	25	30	35	23>	1.4	3	1900
140.5	141.0	ps	0	2	76	22	19.7	24.7	28	20	8	20	50	30	29	20	14>	1.1	X	1430
149.0	149.5	ps	0	6	69	25	21.0	21.3	27	18	9	17	56	27	33	18	12>	1.4	X	1450
152.0	152.5	ps	0	7	71	22	23.3	21.9	27	16	11									
155.0	155.5	ps	0	2	65	33	13.8	23.8	31	18	13									
159.5	160.0	ps	0	21	65	14	31.7	24.9	21	15	6	12	57	31	0	0	10>	1.2	X	1480
164.5	165.0	ms-z	0	72	21	7	15.5	19.3				17	53	30	26	25	14>	1.2	X	1520
169.1	169.6	ms-z	0	90	5	5	4.1	24.1												
174.5	175.0	ms-z	0	77	16	7	48.9	13.1												
175.0	175.5	ms-z	24	86	11	3	14.6	18.9												
177.5		ms-s										12	53	35	0	0	10>	1.0	X	1420
178.1	178.6	ms-z	0	51	36	13	39.7	12.8												
181.4	181.9	ms-d	4	49	40	11	30.7	19.5												
183.6		ms-d										18	51	31	0	0	17>	1.1	1	2485
184.5	185.5	ms-d	0	14	48	38		16.6				32	46	22	25	13	28>	1.4	5	1360
185.5		ms-s										11	51	38	0	0	15>	0.9	X	3640
187.7		ms-s										9	55	36	0	0	10>	1.0	X	2870
188.5	189.0	Pb-x	0	59	29	12	57.80	22.4												

BOREHOLE # M-105
ELEVATION: 620.4 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.8	2.3	p	0	8	64	28	14.4	24.2	31	20	11									
3.5	4.0	p	0	6	54	40	11.0	29.5	44	17	27	60	25	15	0	0	44>	1.0	12	2080
6.0	6.5	b	2	23	38	39	16.1	21.8	41	12	29	75	15	10	0	0	47>	1.0	16	2950
8.5	9.0	b	1	28	36	36	27.3	23.3	40	13	27	68	18	14	0	0	54>	0.8	X	2360
12.5	13.0	gv-mo	8	45	26	29	122.9	22.1	28	13	15	23	59	18	42	0	19>	2.2	X	2490
15.0	15.5	gv-mo	7	44	28	28	126.4	9.6	23	11	12	15	63	22	78	60	6>	1.9	X	2290
19.5	20.0	gv-m	7	45	31	24	115.2	7.8	18	11	7	13	60	27	56	38	6>	1.5	X	2410
22.5	23.0	gv-m	8	28	49	23	50.9	6.3	18	11	7									
27.5	28.0	gv-m	7	41	30	29	97.1	7.3	22	11	11									
33.5	34.0	gv-u	8	43	30	27	113.4	10.0	22	11	11									
39.5	40.0	gv-u	4	41	32	27	76.4	10.1	22	12	10									
44.0	44.5	gv-u	10	42	32	26	114.0	9.1	22	12	10									
44.5	45.0	gv-u	6	43	33	24	97.8	9.2	22	12	10									
49.5	50.0	gv-u	10	43	32	25	123.2	8.8	20	12	8									
54.0	54.5	gv-u	6	43	35	22	105.0	9.1	21	12	9									
54.5	55.0	gv-u	5	45	32	23	94.9	8.9	22	12	10									
59.5	60.0	gv-u	8	42	35	23	102.7	8.3	21	11	10									
64.2	64.7	gv-u	8	43	35	22	109.4	8.4	21	11	10									
66.0	66.5	gv-u	6	44	33	23	93.0	8.5	21	12	9									
69.5	70.0	gv-u	6	44	35	21	86.8	8.5	21	12	9									
72.0	72.5	gv-u	11	40	39	21	77.4	8.7	20	13	7	14	54	32	37	30	7>	1.1	X	2350
78.0	78.5	gv-u	8	37	38	25	77.6	10.0	20	12	8									
80.0	80.5	gv-u	9	32	46	22	45.2	10.5	23	12	11	19	56	25	35	22	11>	1.5	X	2610
84.5	85.0	gv-u	7	34	47	19	50.0	10.7	20	12	8	22	50	28	38	40	13>	1.2	X	2400
87.5	88.0	gm-d	3	46	46	8	10.7	19.5												
90.7	91.2	gm-z	5	86	9	5	13.9	14.7				22	54	24	24	20	8>	1.5	X	2100
92.6		gm-d										24	45	31	18	30	18>	1.0	3	2700
94.5	95.0	gm-d	4	48	31	21	102.5	12.1	23	13	10	15	55	30	38	20	11>	1.2	X	2010
98.0	98.5	gm-s	3	28	38	34	25.1	12.3	30	13	17	26	47	27	33	20	21>	1.2	2	2400
98.2		gs										30	42	28	45	30	20>	1	3	3580
99.5	100.0	gs	3	28	36	36	29.2	12.2	29	12	17	28	46	26	42	30	19>	1.2	2	2230
104.5	105.0	gs-s	2	23	38	39	21.9	14.2	29	14	15									
108.0	108.5	gs-s	7	22	38	40	25.3	14.3	29	13	16									
111.0	111.5	gs-s	1	20	48	32	25.7	14.0	26	13	13	13	36	51	0	0	16>	0.5	X	1590
112.5	113.0	bl	0	19	49	32	23.6	13.9	26	13	13	18	40	42	0	0	19>	0.6	1	1190
114.8		Pb-x										4	36	60	22	18	10>	0.4	X	3790
115.0		Pb										16	35	49	0	40	20>	0.5	1	4250
115.0	115.5	Pb	0	44	32	24	66.2	19.4	24	18	6	15	43	42	0	0	16>	0.7	1	2850
117.0	117.5	Pb	0	42	42	16	37.8	9.2												

BOREHOLE # M-106
ELEVATION: 634.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
0.5	1.0	p	1	11	69	20	16.0	14.0	32	21	11									
3.0	3.5	p	1	15	55	30	15.0	19.0	36	14	22	56	24	20	0	0	40>	0.8	7	2040
5.5	6.0	b	6	31	39	30	38.8	14.0	24	11	13									
9.0	9.5	b	11	34	30	36	73.4	19.8	37	13	24	48	36	16	0	0	24>	1.5	7	1350
11.5	12.0	gv-mo	4	55	28	17	105.6	11.4	18	12	6	18	66	16	54	50	13>	2.8		1670
15.6	16.1	gv-mo	4	50	39	11	25.4													
19.0	19.5	gv-u	10	44	31	25	140.9	7.7	21	11	10	12	66	22	60	47	6>	2.0		2720
22.4		gv-u										11	65	24	75	55	4>	1.8		3130
25.0	25.5	gv-u	8	43	33	24	130.8	6.3	21	10	11									
29.7	30.2	gv-u	7	43	32	25	105.2	7.3	21	11	10	8	62	30	65	43	4>	1.4		1940
34.0	34.5	gv-u	8	42	37	21	97.9	9.0	22	12	10									
35.4		gv-u										14	56	30	72	55	8>	1.2		4270
38.5	39.0	gv-u	8	40	35	25	88.2	9.8	24	12	12	11	57	32	55	40	5>	1.2		3330
45.0	45.5	gv-u	8	40	36	24	85.1	8.6	24	12	12	14	52	34	65	40	10>	1.0		2810
50.0	50.5	gv-u	9	38	37	25	85.4	9.6	21	11	10	15	61	24	80	50	5>	1.7		5090
54.8		gv-u										40	45	15	45	20	16>	1.9	10	4460
55.0		gv-u										15	57	28	32	20	8>	1.4		2200
60.0	60.5	gv-u	8	42	35	23	103.8	8.9	22	11	11	14	56	30	50	37	9>	1.3		2090
63.9		gv-u										11	59	30	52	30	7>	1.3		2270
63.9		gv-u										13	55	32	55	35	9>	1.9		2350
65.0	65.5	gv-u	9	38	42	20	83.1	8.7	21	13	8									
66.5	67.0	gv-u	10	41	36	23	108.4	8.4	20	11	9	9	64	27	40	38	5>	1.6		2120
75.0	75.5	gv-u	7	40	40	20	80.4	10.9	24	12	12									
77.5	78.0	gv-u	8	41	37	22	95.7	10.6	23	11	12	14	57	29	58	39	8>	1.3		3120
79.4		gv-u										19	54	27	60	40	10>	1.3		3140
82.0	82.5	gv-u	13	44	36	20	141.0	11.2	21	12	9	14	58	28	35	37	10>	1.4		2320
84.4	84.9	gm-z	14	95	4	1	3.7													
90.0	90.5	gm-z	55	96	2	2	10.9													
94.9		gm-s										30	45	25	42	21	25>	1.2		2220
97.8	98.3	gm-z	0	85	10	5	20.6													
101.5	102.0	gs-s	5	22	57	21	31.9	15.3	28	15	13	26	56	18	30	30	14>	2.0	1	2310
107.5	108.0	gs-s	5	24	52	24	32.1	13.6	29	13	16									
109.4		gs										34	44	22	37	28	28>	1.3	4	1310
110.5	2.0	gs-s	5	17	60	23	28.8	16.0	29	17	12									
111.9		gs										24	50	26	30	20	23>	1.3	9	2000
114.3		gs										29	51	20	20	0	20>	1.8		1220
118.5	119.0	gs-s	5	17	62	21	29.1	15.4	30	16	14									
122.0		ps										19	55	26	17	0	12>	1.4		1470
124.5	125.0	gs-s	0	2	83	15	25.2	23.2	25	23	2									

BOREHOLE # M-106

ELEVATION: 634.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
127.0	127.5	gs-s	0	2	81	17	25.3	19.5	30	19	11	18	56	26	35	25	16>	1.4		1510
133.5	134.0	gs-s	0	3	72	25	16.3	20.1	35	16	19									
138.5	139.0	gs	3	26	38	36	23.3	16.4	40	12	28	48	29	23	25	18	28>	0.9	5	1740
138.6		ps										51	31	18	35	25	37>	1.1	10	2640
143.3	143.8	gs	16	70	17	13	209.7	13.6	30	12	18	27	51	22	0	0	23>	1.6	3	1700
153.8	154.3	gs	5	36	43	21	55.1	11.1	29	15	14									
154.8	155.3	gs	10	33	43	24	61.7	11.0	28	14	14	11	56	33	50	20	6>	1.1		2750
157.5	158.0	gs	7	28	42	30	38.7	12.6	29	14	15	10	57	33	38	20	7>	1.2		2630
162.5	163.0	gs	7	28	42	30	42.8	12.5	29	13	16	9	57	34	45	22	2>	1.1		3070
162.6		ps										12	55	33	44	20	9>	1.1		2850
165.5	166.0	gs	7	28	42	30	43.2	14.1	28	13	15									
169.7		ps										12	54	34	48	0	7>	1.1	X	2540
175.0	175.5	gs	10	29	40	31	13.9	13.4	27	13	14									
177.5	178.0	gs-s	4	19	48	33	37.9	13.8	29	13	16									
184.5	185.0	gs-s	5	17	53	30	33.2	15.1	30	13	17									
188.0	188.5	gs-s	4	22	44	34	23.6	18.0	33	14	19									
195.0	195.5	gs-s	5	19	48	33	22.7	17.3	32	15	17									
196.5	197.0	gs	8	26	45	29	42.5	16.5	30	15	15									
200.4	200.9	ms-d	28	44	39	17	138.5													
204.9	205.4	ms-d	21	51	33	16	149.9													
207.6	208.1	ms-s	0	20	57	23	36.9													

BOREHOLE # M-107
ELEVATION: 595.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
0.5	1.0	c	4	66	18	16	207.5	14.5	25	11	14									
2.5	3.0	b	5	40	20	40	90.1	19.5	39	14	25									
4.2	4.7	b	10	46	23	31	148.9	14.9	35	11	24	41	43	16	0	0	37>	1.8	X	1620
9.0	9.5	gv-m	13	43	36	21	114.3	7.8	23	11	12	22	56	22	72	45	20>	1.7	X	1800
14.0	14.5	gv-m	6	42	34	24	99.7	7.5	22	11	11									
18.5	19.0	gv-m	5	43	35	22	98.3	9.1	23	11	12									
21.0	21.5	gv-m	7	51	29	20	114.3	10.0	24	11	13									
28.5	29.0	gv-m	7	41	37	22	87.8	9.2	23	10	13									
30.0	30.5	gv-m	4	41	33	26	80.6	7.9	18	10	8									
33.0	33.5	gv-m	5	37	35	28	62.8	11.1	24	12	12									
36.0	36.5	gv-u	8	45	32	23	107.4	9.7	22	11	11									
39.5	40.0	gv-u	4	48	30	22	115.1	9.1	20	11	9									
43.3	43.8	gv-u	7	43	36	21	99.0	9.9	22	11	11									
48.5	49.0	gv-u	7	43	36	21	96.3	9.3	22	12	10									
53.5	54.0	gv-u	12	50	35	15	83.3	7.7	19	12	7									
55.5	56.0	gv-u	17	45	37	18	158.5	10.2	21	12	9									
59.5	60.0	gv-z	1	96	3	1	2.9	17.1												
62.8	63.3	gv-z	18	95	3	2	3.7	14.1												
67.0	67.5	gv-u	8	36	41	23	65.2	11.5	22	11	11	9	64	27	40	40	5>	1.6	X	2710
72.5	73.0	gv-u	3	39	42	19	65.9	10.6	19	11	8									
74.0	74.5	gv-u	4	40	42	18	56.6	10.8	19	12	7									
82.0	82.5	gv-u	8	46	37	17	77.4	10.3	18	12	6	12	64	24	45	38	2>	1.8	X	2910
84.8	85.3	gs	6	29	50	21	38.8	13.3	23	13	10	28	51	21	36	30	22>	1.6	0	2400
89.0	89.5	gs	3	33	51	16	45.6	11.2	21	12	9	28	49	23	43	37	22>	1.4	1	2410
92.0	92.5	gs-z	6	89	9	2	3.5	19.2												
94.5	95.0	gs-z	2	89	9	2	4.9	18.4												
102.5	103.0	gs-s	4	19	59	22	23.3	17.3	27	15	12	29	46	25	25	12	27>	1.2	X	1700
105.0	105.5	gs-s	3	17	57	26	23.4	17.6	26	15	11									
112.5	113.0	gs-s	2	17	66	17	19.0	20.4	28	15	13									
115.0	115.5	gs-s	4	21	63	16	22.2	20.0	27	15	12									
118.0	118.5	ms-z	71	86	10	4	6.4	8.7												
129.4	129.9	ms-z	64	67	25	8	127.4	11.5												

BOREHOLE # M-108
ELEVATION: 619.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
0.5	1.0	p	0	11	66	23	17.2	23.0	37	20	17									
2.4	2.9	r	1	25	45	30	20.9	22.9	39	13	26									
6.5		b										33	56	11	0	0	23>	3.3	8	1670
7.4	7.9	pe	0	92	3	5	3.2	20.4												
11.3	11.8	pe	0	95	5	0	2.6	22.1												
14.7	15.2	gv-m	9	42	40	18	70.8	11.3	18	12	6									
16.5		gv-m										10	65	25	53	30	1>	1.8	X	2440
21.0	21.5	gv-m	5	51	28	21	141.5	9.3	21	10	11									
26.0		gv-m										12	63	25	65	45	2>	1.7	X	2480
28.5	29.0	gv-m	4	45	31	24	112.0	8.5	23	11	12									
31.8	32.3	gv-mz	10	79	16	5	15.8	13.0												
35.0	35.5	gv-mz	0	93	4	3	3.5	15.2												
40.0		gv-u										10	61	29	67	45	1>	1.4	X	2550
43.5	44.0	gv-u	5	45	29	26	113.0	8.2	24	11	13									
48.5	49.0	gv-u	14	41	34	25	133.0	9.3	24	11	13	10	60	30	48	33	4>	1.3	X	2440
51.0	51.5	gv-u	5	41	32	27	87.5	9.1	24	11	13									
53.8		gv-u										19	55	26	47	30	13>	1.4	X	2200
58.5	59.0	gv-u	7	40	39	21	84.8	10.2	22	11	11									
61.5	62.0	gv-z	38	92	5	3	10.9	10.5												
68.1	68.6	gv-u	9	41	41	18	98.1	11.2	20	12	8	20	56	24	30	30	8>	1.6	X	2200
73.6	74.0	gv-u	5	34	47	19	50.9	9.4	23	12	11									
78.5	79.0	gv-u	15	41	38	21	136.4	11.0	20	12	8	18	61	21	31	22	8>	2.0	X	2790
83.2	83.7	gv-u	4	40	41	19	65.9	11.6	23	12	11									
88.3	88.8	gv-u	14	40	43	17	75.4	11.5	19	14	5	18	59	23	35	34	9>	1.8	0	2385
90.1	90.6	gv-u	8	39	41	20	81.2	11.5	21	8	13									
92.7	93.2	gv-u	7	39	42	19	82.5	10.8	23	12	11									
95.8		gv-u										12	62	26	30	35	4>	1.6	X	2520
97.6	98.1	gm-z	27	78	18	4	43.1	12.1												
100.0		gm-s										21	54	25	20	18	12>	1.4	2	950
102.4		gs-s										41	38	21	25	20	32>	1.2	7	2520
103.1	103.6	gs-s	2	4	71	25	20.3	17.7	31	17	14									
106.5	107.0	gs-s	2	3	77	20	21.5	15.2	33	17	16									
108.7		gs-s										44	38	18	30	25	30>	1.4	7	2600

BOREHOLE # M-109
ELEVATION: 624.2 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
3.0	3.5	p	0	4	52	44	10.4	29.2	60	17	43									
5.0	5.5	p	0	10	57	33	15.7	24.5	42	15	27									
8.5	9.0	b	2	30	30	40	26.1	23.7	44	12	32									
10.0	10.5	b	7	37	16	47	83.2	24.6	36	11	25	67	19	14	0	0	44>	0.9	1	3140
12.5	13.0	pe	5	51	37	12	33.5	18.9	16	13	3	13	67	20	0	0	11>	2.3	X	1650
15.0	15.5	gv-mo	5	51	33	16	64.9	8.7	20	11	9	15	65	20	40	37	6>	2.2	X	1610
19.0	19.5	gv-m	6	39	32	29	85.1	7.4	21	11	10	9	62	29	68	40	3>	1.4	X	2110
20.5	21.0	gv-m	5	41	44	15	84.4	7.4	21	11	10									
25.5	26.0	gv-m	12	41	36	23	119.2	6.4	20	10	10									
34.0	34.5	gv-u	6	44	32	24	99.8	9.5	21	11	10	12	55	33	57	37	6>	1.1	X	2390
39.5	40.0	gv-u	4	31	42	27	48.1	9.5	23	11	12									
44.5	45.0	gv-u	5	42	34	24	89.4	9.9	22	11	11									
49.5	50.0	gv-u	5	44	31	25	101.4	10.0	22	12	10									
54.5	55.0	gv-u	4	42	35	23	81.6	8.3	22	11	11									
57.5	58.0	gv-u	5	46	33	21	116.3	8.7	21	11	10									
64.0	64.5	gv-u	5	36	40	24	56.7	8.5	22	11	11	12	55	33	45	20	7>	1.1	X	1920
66.0	66.5	gv-u	4	43	39	18	88.4	9.3	22	12	10									
72.5	73.0	gv-u	6	33	43	24	52.5	10.6	26	12	14	17	53	30	40	30	11>	1.2	X	2260
78.0	78.5	gv-u	6	43	36	21	105.0	8.9	22	11	11	9	60	31	37	31	6>	1.3	X	1910
83.1	83.6	gm-z	2	88	9	3	5.7	20.5												
86.5	87.0	gm-d	7	35	46	19	123.5	8.6	21	12	9	13	57	30	40	30	8>	1.2	X	1960
89.5	90.0	gm-d	11	34	47	19	71.3	8.6	19	11	8	14	59	27	48	35	8>	1.5	X	2070
92.5	93.0	gm-z	40	95	3	2	5.5	9.9												
97.7	98.2	gm-z	25	87	11	2	10.3	16.2												
104.3	104.8	gs-s	4	23	52	25	30.5	13.8	25	13	12	26	46	28	28	20	21>	1.1	1	2010
109.0	109.5	gs-s	4	22	53	25	33.5	13.5	26	13	13									
112.0	112.5	gs-s	3	20	58	22	24.6	15.8	26	14	12									
119.5	120.0	gs-s	2	22	52	26	24.8	15.9	27	14	13									
123.9	124.4	gs-s	1	21	54	25	23.6	16.3	29	14	15									
129.2	129.7	gs-s	1	17	55	28	23.3	18.2	28	15	13									
130.0	130.5	gs-s	2	16	55	29	18.4	21.1	28	15	13									
138.0	138.5	gs-s	0	11	57	32	17.0	17.4	27	13	14									
139.5	140.0	gs-s	2	20	51	29	24.0	15.3	26	12	14	14	55	31	18	30	13>	1.2	X	2410
144.5	145.0	gs-s	1	11	59	30	16.8	18.0	29	14	15	31	32	37	30	25	30>	0.6	1	1950
148.2	148.7	ps	1	0	57	43	8.4	22.1	28	18	10	18	56	26	20	20	13>	1.4	2	1190
150.4	150.9	ps	1	0	75	25	17.3	24.9	41	18	23									
154.3	154.8	ps	0	49	40	11	20.3	18.1												

OREHOLE # M-109

LEVATION: 624.2 ft

AMPLE DENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
157.0	157.5	ps	0	55	37	8	14.1	20.1												
158.5	159.0	ps	0	55	37	8	13.3	22.0				14	57	29	0	20	15>	1.3	X	1260
162.0	162.5	ps	0	13	80	7	5.6	25.2												
163.6	164.1	ps	0	11	82	7	4.8	28.2												
165.5	166.0	ps	0	4	74	22	15.3	32.7	34	24	10	15	49	36	0	0	12>	0.9	2	1460
167.5	168.0	ps	0	3	74	23	13.8	28.5	27	17	10									
169.2	169.7	ps	0	19	57	24	23.0	20.0	23	15	8	18	46	36	30	10	24>	0.9	X	2270
170.5	171.0	ps	1	28	51	21	39.2	19.4	22	14	8	15	47	38	20	30	20>	0.8	X	2410
174.0	174.5	ms-z	0	85	10	5	5.4	11.8												

BOREHOLE # M-110
ELEVATION: 572.6 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
35.5		gv-u										10	56	34	67	43	6>	1.1	X	2070
37.5	38.0	gv-u	9	48	38	14	49.2	10.4				16	56	28	45	37	8>	1.4	X	2880
38.5	39.0	gm-z	2	83	14	3	10.2	18.6												
39.1		gm-d										13	54	33	37	46	6>	1.1	X	2770
40.5	41.0	gm-d	9	45	40	15	45.0	11.2	20	12	8									
47.0	47.5	gm-z	1	92	4	4	2.4	26.1												
48.3		gm-d										7	76	17	40	35	8<	2.9	X	2610
48.3		gm-d										6	65	29	50	55	4<	1.5	X	3680
50.4		gm-d										4	70	26	50	56	11<	1.8	X	2880
52.8		gv-u										4	74	22	30	30	16<	2.2	X	3510
52.8		gm-d										4	74	22	30	30	16<	2.2	X	3510
53.4		gm-d										10	63	27	52	32	1<	1.5	X	3540
54.5	55.0	gm-d	7	38	40	22	70.9	9.0	22	11	11									
55.5	56.0	gm-d	7	31	45	24	48.5	9.8	22	11	11	11	64	25	50	35	3>	1.7	X	3920
56.9		gm-d										11	64	25	50	35	3>	1.7	X	3920
62.7		gm-d										15	56	29	0	0	7>	1.3	X	2400
63.5		gm-d										19	55	26	28	30	11>	1.4	X	2390
68.5	69.0	gm-z	8	89	8	3	14.5	25.3				9	67	24	50	53	3<	1.9	X	2900
70.5	71.0	gs-s	5	15	60	25	26.1	16.3	29	14	15	46	34	20	28	30	30>	1.1	7	4760
75.0	75.5	gs	5	28	47	25	39.3	12.1	24	12	12									
78.0	78.5	gs	10	26	50	24	40.6	12.4	28	13	15									
80.7		gs										39	40	21	42	20	22>	1.3	3	4310
85.0	85.5	gs-s	7	24	57	19	36.7	15.4	28	14	14									
90.0	90.5	gs-s	3	16	59	25	23.0	18.0	28	14	14									
90.5	91.0	gs-s	2	18	60	22	21.9	19.8	29	16	13	49	29	22	40	40	33>	0.9	5	4140
94.8	95.3	gs-s	4	16	56	28	21.6	20.7	31	15	16									
96.0	96.5	gs-z	7	68	20	12	126.8	16.6												
102.5	103.0	gs-s	12	19	56	25	28.3	18.7	29	15	14	34	37	29	0	0	27>	0.9	5	2440
110.0	110.5	gs-s	2	19	53	28	21.5	19.0	28	14	14	41	33	26	20	20	26>	0.8	2	3680
111.0	111.5	gs-s	4	19	53	28	22.4	19.0	28	15	13									
114.0	114.5	gs-s	3	20	60	20	23.2	19.1	28	14	14									
117.0	117.5	gs-s	12	18	56	26	24.6	17.5	27	13	14	31	41	28	40	40	22>	1.0	3	3520
120.9	121.4	gs-s	4	19	54	27	24.4	18.2	27	14	13									
123.0	123.5	gs-s	3	17	64	19	20.9	21.6	29	18	11									
125.5	126.0	gs-s	9	16	62	22	20.2	21.0	30	16	14	29	41	30	20	40	25>	0.9	4	2780
132.0	132.5	gs-s	1	18	54	28	21.7	19.4	27	14	13									
134.3		gs-s										25	43	32	40	40	19>	0.9	4	2640

BOREHOLE # M-111
ELEVATION: 578.5 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
29.5	30.0	gv-u	10	44	38	18	117.6	9.3	21	12	9	13	57	30	85	50	9>	1.3	X	3160
31.1	31.6	gv-u	16	46	37	17	168.0	9.7	20	14	6	14	53	33	59	35	11>	1.1	X	3100
36.0	36.5	gm-z	23	71	23	6	16.9	15.0												
41.1	41.6	gm-z	63	84	11	5	22.0	12.8												
44.4		gm-d										10	63	27	70	45	3>	1.5	X	4020
44.5	45.0	gm-d	10	36	40	24	75.9	10.0	20	12	8									
46.0	46.5	gm-z	32	90	6	4	9.1	15.7												
49.0	49.5	gm-d	20	49	34	17	229.4	8.2	19	13	6	15	58	27	44	40	6>	1.4	X	2600
52.9	53.4	gm-z	3	97	2	1	2.2	19.6												
57.0	57.5	gm-z	27	97	2	1	7.3	17.0												
64.3	64.8	gm-s	2	12	72	16	23.0	19.3	22	20	2	24	51	25	53	45	13>	1.4	1	3740
68.5	69.0	gm-s	1	10	78	12	10.1	20.0	21	21	0	20	53	27	55	57	12>	1.3	1	2960
73.5	74.0	gs	6	29	51	20	45.7	12.3	23	15	8	30	45	25	50	20	20>	1.2	3	3650
75.4		gs-s										32	43	25	30	35	20>	1.1	0	2820
78.5	79.0	gs-s	11	22	54	24	42.6	14.6	28	14	14	37	41	22	40	28	22>	1.3	1	3500
81.0	81.5	gs-s	3	17	57	26	28.1	17.3	29	14	15	46	32	22	36	22	32>	0.9	1	3290
87.0	87.5	gs-s	2	18	55	27	25.2	16.7	30	14	16									
92.5	93.0	gs-s	2	17	60	23	25.2	17.5	29	15	14	44	33	23	40	25	33>	0.9	1	3390
98.0	98.5	gs-s	2	16	58	26	25.0	16.7	31	15	16	32	44	24	30	20	24>	1.2	1	1420
99.5	100.0	gs-s	2	17	59	24	23.9	17.0	31	15	16									
102.1		gs-s										35	43	22	32	35	29>	1.3	1	1880
104.3	104.8	gs-s	3	15	58	27	24.6	18.1	31	11	20									
105.0	105.5	gs-s	12	17	58	25	33.8	17.9	31	15	16									
108.0	108.5	gs-s	3	17	59	24	20.3	19.4	31	16	15	35	40	25	30	22	32>	1.0	0	1810
112.0	112.5	gs-s	4	16	59	25	20.2	19.6	31	17	14	25	48	27	25	21	17>	1.2	2	1390
117.5	118.0	gs-s	3	19	57	24	20.3	20.1	31	15	16	23	53	24	0	0	24>	1.5	X	1590
121.0	121.5	gs-s	3	17	54	29	20.1	19.0	32	16	16	20	30	50	0	30	18>	0.4	2	1890
123.4		gs-s										38	37	25	38	33	27>	1.0	3	2650
127.5	128.0	ms-z	19	91	5	4	6.5	19.7												
134.5	135.0	ms-z	1	90	6	4	19.8	20.2												
136.0	135.5	ms-z	2	90	6	4	10.6	21.2												
138.5	139.0	ms-z	32	62	0	38	110.7	17.5												

BOREHOLE # M-112
ELEVATION: 628.2 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
0.0	0.5	p	0	15	63	22	18.5	20.0	33	22	11									
1.0	1.5	p	0	13	58	29	15.7	21.2	35	19	16									
4.2	4.7	p	0	9	52	39	12.2	27.7	45	15	30									
7.0	7.5	r	0	26	35	39	17.7	21.7	48	13	35									
10.5	11.0	b	5	41	27	32	103.3	20.5	33	11	22									
12.9		gv-mo										16	65	19	15	42	8>	2.3	2	1560
13.3		gv-mo										15	64	21	27	54	9>	2.0	X	2350
14.5	15.0	gv-m	9	44	32	24	119.6	7.9	21	11	10	7	64	29	63	36	2>	1.5	X	2350
19.5	20.0	gv-m	11	42	33	25	138.0	6.8	21	10	11	8	64	28	63	40	1<	1.5	X	2440
22.5	23.0	gv-m	8	43	35	22	106.1	6.6	19	11	8									
26.5	27.0	gv-u	6	49	34	17	137.0	7.6	18	10	8									
29.5		gv-u										9	63	28	60	29	1<	1.5	X	1960
31.1		gv-u										10	64	26	61	48	0	1.7	X	2560
34.5	35.0	gv-u	8	43	33	24	124.1	7.0	19	11	8									
37.0	37.5	gv-u	8	41	35	24	104.9	7.2	21	11	10									
39.5	40.0	gv-u	6	44	32	24	118.0	7.4	21	10	11	10	63	27	62	35	1>	1.6	X	1990
44.5	45.0	gv-u	13	43	33	24	137.4	7.4	20	11	9									
49.0	49.5	gv-u	10	41	34	25	93.8	7.4	19	11	8									
51.5	52.0	gv-u	10	40	30	30	96.2	8.9	21	10	11									
54.4		gv-u										8	63	29	66	32	2<	1.5	X	2180
60.0	60.5	gv-z	4	95	3	2	2.4	19.4												
67.8		gv-u										8	63	29	67	40	2>	1.5	X	2280
68.2	68.7	gv-z	3	89	10	1	4.9	16.4												
70.8		gv-u										9	66	25	60	31	2>	1.7	X	2010
72.5	73.0	gv-u	11	42	34	24	123.8	8.6	22	11	11									
78.5	79.0	gv-u	13	42	34	22	133.7	8.6	24	12	12	12	55	33	42	30	5>	1.1	X	2070
84.5	85.0	gv-u	12	43	36	21	131.3	10.3	23	11	12									
89.5	90.0	gv-u	3	42	34	24	119.0	9.5	24	11	13	10	58	32	35	18	9>	1.2	X	2070
94.2	94.7	gv-u	3	42	34	24	114.7	14.3	23	11	12									
99.5	100.0	gv-u	2	35	41	24	63.4	9.8	24	12	12	19	53	28	30	20	14>	1.2	X	2060
103.7	104.2	gv-u	3	45	35	20	126.0	10.6	21	11	10	14	56	30	37	20	8>	1.2	X	1830
109.5	110.0	gv-u	2	38	40	22	94.6	9.7	21	13	8	11	59	30	35	27	3>	1.3	X	2020
114.2	114.7	gv-u	3	41	37	22	105.2	11.1	22	12	10									
119.3	119.8	gv-u	2	40	38	22	92.1	10.6	22	12	10	11	58	31	45	33	5>	1.2	X	1930
124.0	124.5	gv-u	2	40	40	20	78.9	9.9	21	12	9									
127.9	128.4	gv-u	7	45	36	19	121.3	9.8	21	12	9									
130.0		gv-u										10	59	31	50	32	2>	1.3	X	1890

BOREHOLE # M-112
ELEVATION: 628.2 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
133.2	133.7	gv-u	8	41	40	19	121.3	9.0	22	11	11									
139.2	139.7	gv-u	9	44	37	19	111.6	10.0	20	12	8	10	58	32	40	38	0	1.2	X	1950
144.3	144.8	gv-u	8	45	37	18	90.9	10.5	19	12	7									
146.0	146.5	gv-u	8	45	36	19	138.0	10.4	20	12	8									
150.0		gv-u										10	58	32	30	25	4>	1.2	X	2080
150.0		gv-u										9	57	34	55	50	4>	1.1	X	3160
153.0	153.5	gv-u	9	38	40	22	96.1	11.2	20	13	7	11	60	29	29	27	5>	1.4	X	2160
154.6		ms-d										16	38	46	23	0	12>	0.5	X	950
155.7		ms-d										16	39	45	23	15	16>	0.6	X	955
156.0	156.5	ms-z	1	60	29	11	44.4	13.9	21	15	6									

BOREHOLE # M-113
ELEVATION: 618.9 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
0.4	0.9	fill	1	32	46	22	20.3	9.3	22	15	7									
2.2	2.7	pks	1	82	7	11	215.4	13.6												
8.0	8.5	b	2	31	41	28	31.7	21.1	32	12	20	54	28	18	0	0	30>	1.1	6	1480
14.0	14.5	b	4	45	26	29	108.3	19.0	32	12	20	35	50	15	0	0	34>	2.2	4	2100
17.5	18.0	gv-mo	6	44	33	23	100.6	10.1	23	12	11	17	66	17	65	50	17>	2.7	1	1580
22.5	23.0	gv-m	8	43	29	28	122.9	8.6	21	11	10	10	60	30	68	40	2>	1.3	X	2240
26.5	27.0	gv-m	11	46	31	23	139.4	8.2	21	10	11									
34.5	35.0	gv-u	7	46	30	24	130.2	8.6	21	10	11	13	64	23	25	13	9>	1.8	X	1110
39.5	40.0	gv-u	6	45	30	25	106.2	9.0	21	11	10									
44.0	44.5	gv-u	7	41	38	21	89.7	8.7	24	11	13									
48.3	48.8	gv-u	5	36	35	29	26.0	12.1	27	12	15									
54.5	55.0	gv-u	10	43	34	23	130.7	9.0	22	11	11									
59.5	60.0	gv-u	5	44	36	20	96.8	8.3	23	11	12									
63.1	63.6	gv-u	8	42	36	22	101.7	8.6	23	11	12									
69.5	70.0	gv-u	8	41	37	22	89.9	9.6	23	12	11									
72.5	73.0	gv-u	6	35	39	26	59.3	13.1	26	12	14	14	55	31	55	10	11>	1.2	X	2790
78.5	79.0	gv-u	9	43	40	17	106.2	9.8	22	12	10									
83.6	84.1	gv-u	16	42	37	21	137.4	9.5	21	12	9	15	59	26	30	21	11>	1.5	X	1470
84.2		gv-u										15	59	26	30	21	11>	1.5	X	1470
86.3	86.8	gv-u	8	43	37	20	108.2	11.2	20	12	8	13	57	30	40	20	8>	1.2	X	1960
92.0	92.5	gm-z	11	94	3	3	4.0	15.3												
98.2	98.7	gm-z	25	93	4	3	4.0	14.6												
104.5	105.0	gm-z	19	91	6	3	6.6	13.8												
105.5	106.0	gs	5	29	49	22	38.2	12.7	24	13	11	26	50	24	40	35	15>	1.4	0	1920
109.5	110.0	gs	5	29	49	22	39.7	11.6	25	12	13									
110.5	111.0	gs	7	26	49	25	42.6	11.1	25	13	12									
114.5	115.0	gs-s	1	17	45	38	20.1	15.6	36	13	23	33	32	35	0	0	32>	0.6	2	1710
119.5	120.0	gs-s	5	20	43	37	24.0	18.2	37	13	24	32	29	39	0	0	31>	0.5	3	1850

BOREHOLE # M-119
ELEVATION: 622.6 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
72.0	72.5	gv-u	6	30	43	27	36.3	12.2	29	12	17	26	48	26	33	33	17>	1.2	X	2240
75.5	76.0	gv-u	3	32	60	8	10.1	14.2	17	16	1	5	69	26	30	27	8<	1.8	X	2590
77.1	77.6	gv-z	20	76	16	8	43.1	8.9												
83.4		gv-u										13	55	32	35	20	8>	1.1	X	1980
83.5	84.0	gv-u	10	33	40	27	62.0	11.7	27	13	14	20	55	25	37	30	13>	1.5	X	2200
86.0	86.5	gv-u	11	42	38	20	76.3	9.9	21	11	10	14	57	29	45	38	12>	1.3	X	2150
91.0	91.5	gm-z	43	96	2	2	4.4	10.5				16	58	26	25	30	12>	1.5	X	1240
100.5	101.0	gm-z	1	68	23	9	35.7	36.4												
104.1		gs										24	40	36	32	35	26>		X	2250
108.5	109.0	gs-s	3	21	52	27	27.5	17.0	28	14	14	22	46	32	32	28	19>	1.0	0	2720

BOREHOLE # M-120
ELEVATION: 580 ft

SAMPLE IDENTIFICATION — PARTICLE SIZE DISTRIBUTION — ENGINEERING DATA — MINERALOGY OF THE <2um FRACTION

DEP TOP	DEP BOT	UNIT	TOT GVL %	SD %	<2mm ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
0.0	0.5	c	1	23	50	27	13.3	51.5	47	26	21									
3.0	3.5	c	1	4	76	20	35.6	19.8	33	15	18									
5.0		c										68	24	8	0	15	35>	1.8	13	1400
6.0	6.5	c	1	88	4	8	30.1	18.0												
7.0		c										69	21	10	0	0	40>	1.3	16	3510
7.3		c										77	15	8	0	0	41>	1.8	21	1340
10.3		c										61	28	11	0	0	35>	1.7	19	2370
11.2	11.7	c	2	83	11	6	25.3	26.6												
16.0	16.5	c	1	7	34	59	5.5	29.4	37	14	23									
17.4		c										19	53	28	30	25	10>	1.3	9	1990
21.5	22.0	c	1	53	35	12	68.0	18.2	16	16	0									

BOREHOLE # M-122
ELEVATION: 605 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
2.0	2.5	gv-mo	5	45	34	21	118.2	7.6	23	11	12	16	69	15	63	48	2>	3.1	X	2420
5.5	6.0	gv-mo	4	46	32	22	116.5	9.5	22	12	10									
13.0	13.5	gv-u	6	43	35	22	103.2	10.2	23	13	10									
17.5	18.0	gv-u	7	41	38	21	95.9	9.6	26	12	14									

BOREHOLE # M-123
ELEVATION: 594 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
DEP TOP	DEP BOT	UNIT	TOT GVL %	SD %	<2mm ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.6		c										49	30	21	0	0	36>	0.9	6	1820
2.0	2.5	c	5	37	41	22	63.5	14.8	28	14	14									
3.4		c										52	30	18	13	0	29>	1.1	10	641
5.5	6.0	c	12	64	23	13	89.8	19.2	20	14	6	26	47	27	0	0	10>	1.2	5	700
15.8		gv-u										8	59	33	98	65	1>	1.2	X	2510
19.0	19.5	gv-u	5	45	34	21	109.3	10.6	22	11	11									
22.5	22.5	gv-u	6	43	35	22	94.1	8.4	24	12	12									

BOREHOLE # M-124
ELEVATION: 637.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
2.0	2.5	r	1	23	36	41	13.3	21.4	47	14	33	65	21	14	0	0	40>	1.0	8	1840
5.5	6.0	r	2	26	46	28	26.9	21.7	31	14	17									
8.5	9.0	b	3	34	37	29	39.2	18.2	28	13	15	61	24	15	0	0	48>	1.1	9	1850
12.5	13.0	b	4	46	25	29	114.7	22.7	31	11	20	48	32	20	0	0	33>	1.1	5	1510
17.0	17.5	gv-mo	7	46	30	24	126.3	9.8	22	11	11	16	67	17	65	50	11>	2.7	3	1780
20.0	20.5	gv-m	7	46	30	24	117.3	8.3	20	11	9									
29.5	30.0	gv-u	8	54	26	20	118.5	5.8	17	11	6	9	60	31	65	38	2>	1.3	X	2740
34.5	35.0	gv-u	8	42	29	29	104.8	6.6	22	11	11									
38.0	38.5	gv-u	10	43	30	27	129.1	7.1	22	10	12	11	64	25	90	45	5>	1.8	X	2620
42.0	42.5	gv-u	8	42	32	26	108.9	8.1	23	10	13									
48.0	49.0	gv-u	11	42	34	24		9.4				10	57	33	67	35	7>	1.2	X	2890
54.5	55.0	gv-u	8	42	34	24	95.0	9.2	24	11	13	10	55	35	60	29	14>	1.1	X	2290
59.5	60.0	gv-u	9	43	34	23	113.7	8.6	23	12	11	16	54	30	60	32	7>	1.2	X	2430
62.0	62.5	gv-u	9	43	34	23	105.4	8.2	22	12	10	16	55	29	52	28	10>	1.3	X	2400
67.5	68.0	gv-u	11	42	37	21	104.7	8.6	22	11	11	13	56	31	50	33	4>	1.2	X	2530
72.0	72.5	gv-u	9	43	36	21	74.9	8.6	22	12	10									
77.5	78.0	gv-u	11	43	37	20	115.1	9.6	21	12	9	15	56	29	52	30	5>	1.3	X	2065
78.0	78.5	gv-u	11	45	36	19	131.2	9.3	20	12	8									
82.5	83.0	gv-u	5	38	41	21	65.6	9.9	22	13	9									
84.6		gv-u										20	50	30	37	35	12>	1.1	X	2710
85.5		gv-u										12	58	30	33	25	5>	1.3	X	2065
87.0	87.5	gv-u	8	35	42	23	59.9	11.5	24	13	11	20	51	29	38	30	11>	1.2	X	2430

BOREHOLE # M-125

ELEVATION: 610.2 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP	DEP	UNIT	GVL	SD	ST	CL	Cu	W%	LL	PL	PI	EXP	ILL	C-K	CAL	DOL	VERM	DI	HSI	INT
TOP	BOT		%	%	%	%						%	%	%			IND			CPS
4.5		r										56	28	16	0	0	35>	1.2	5	1630
5.7	6.2	gv-mo	4	44	29	27	104.9	10.2	25	12	13	16	65	19	46	60	10>	2.3	0	2070
8.7	9.2	gv-m	9	40	33	27	90.1	12.1	24	12	12	16	55	29	60	40	11>	1.3	0	2220
14.5	15.0	gv-m	8	41	34	25	90.2	9.5	24	11	13	12	56	32	60	30	4>	1.1	X	2600
17.0	17.5	gv-m	12	39	36	25	98.7	10.2	24	12	12									
19.5	20.0	gv-u	6	42	37	21	85.6	9.7	24	11	13									
22.0	22.5	gv-u	9	40	36	24	90.2	10.2	24	12	12									
25.7		gv-u										15	55	30	43	28	7>	1.3	X	1900
27.0	27.5	gv-u	9	40	36	24	87.2	9.6	25	13	12									
30.0	30.5	gv-u	10	27	44	29	43.6	15.7	31	14	17									
34.5	35.0	gv-u	5	37	31	32	63.2	8.2	28	13	15	15	53	32	50	36	5>	1.1	X	2370
39.0	39.5	gv-u	7	43	31	26	110.2	9.1	23	12	11									
42.4	42.9	gv-u	8	42	33	25	103.7	8.5	24	12	12									
44.9		gv-u										13	57	30	36	25	7>	1.3	X	1950
48.6	49.1	gv-u	10	41	36	23	103.1	9.0	22	11	11									
52.0	52.5	gv-u	14	42	35	23	124.3	8.6	23	12	11									
55.0	55.5	gv-u	8	40	38	22	89.2	9.3	22	11	11	15	55	30	48	38	10>	1.2	X	1850
57.7	58.2	gm-z	1	61	32	7	14.4	21.5												
64.2	64.7	gm-z	13	67	23	10	47.2	13.3												
65.1		gm-s										10	64	26	40	42	2>	1.7	X	2800
66.9		gm-s										16	58	26	95	16	5>	1.5	X	2480
67.0	67.5	gs	7	37	36	27	70.1	10.3	22	11	11									
74.5	75.0	gs	4	31	46	23	44.2	10.9	24	13	11	24	53	23	35	20	14>	1.6	1	1850
78.0	78.5	gs	5	29	49	22	40.8	11.6	23	14	9									
83.0	83.5	gs-s	3	19	58	23	26.0	14.0	26	16	10									
85.0	85.5	gs-s	8	22	54	24	34.5	13.7	26	15	11	32	48	20	37	27	21>	1.6	2	2060
90.0	90.5	gs-s	3	17	62	21	24.5	15.2	26	16	10									
92.5	93.0	gs-s	1	6	82	12	7.3	16.8	26	22	4	21	59	20	25	15	10>	2.0	X	1210
95.0	95.5	gs-s	1	9	81	10	7.0	14.4	22	21	1									
99.5	100.0	gs-s	3	17	60	23	24.0	17.9	28	17	11									
102.0	102.5	gs-s	2	18	60	22	23.5	17.1	28	17	11	25	50	25	0	0	18>	1.3	X	1190
107.8	108.3	ps	1	2	75	23	15.4	16.5	31	21	10	17	54	29	35	37	12>	1.2	X	2190
113.0	113.5	ps	1	1	87	12	12.7	9.7	25	23	2									
115.0	115.5	ps	0	0	86	14	9.1	20.3	26	23	3	18	57	25	20	20	12>	1.5	X	1060
116.9	117.4	ps	1	2	85	13	7.4	19.5	26	23	3									

BOREHOLE # M-125
ELEVATION: 610.2 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
124.2	124.7	ps	1	0	90	10	7.2	9.4	26	24	2	15	57	28	27	31	10>	1.3	X	1690
129.1	129.6	ps	0	2	90	8	4.5	17.1	24	24	0									
131.0	131.5	ps	0	0	88	12	9.5	24.7	26	24	2									
133.5		ps										14	62	24	42	30	7>	1.7	X	1990
137.9	138.4	ps	0	0	60	40	10.3	25.0	36	19	17									
141.0	141.5	ps	2	3	67	30	13.9	26.4	31	20	11									
145.0	145.5	ps	1	5	68	27	13.5	31.5	34	22	12	30	45	25	25	0	25>	1.2	4	1450
147.2	147.7	ps	2	28	52	20	22.4	17.0	23	15	8									
154.3	154.8	ps	2	9	61	30	14.1	29.0	36	19	17	31	45	24	0	0	25>	1.2	X	1235
160.5	161.0	ms-d	3	24	55	21	34.9	21.2	28	16	12	24	44	32	25	18	22>	0.9	X	1860

BOREHOLE # M-126

ELEVATION: 571.4 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
	35.0	gv-u										17	54	29	42	25	9>	1.2		1780
	30.6	gv-u										14	53	33	53	35	9>	1.1	X	1980
2.5	3.0	c	0	3	77	20	31.5	14.9	26	14	12	42	43	15	0	0	29>	2.0	4	1180
6.4	6.8	c	0	17	76	7	4.0	17.5												
11.5	12.0	c	0	90	6	4	2.9	21.6												
18.3	18.8	c	1	97	1	2	1.8	20.9												
22.5	23.0	c	2	93	5	2	3.9	17.8												
33.5	34.0	gv-u	14	45	38	17	141.1	9.8	21	11	10	10	60	30	60	40	8>	1.3	X	2570
37.5	38.0	gv-u	14	40	44	16	112.4	10.8	22	12	10									
43.0	43.5	gv-u	7	34	43	23	58.6	11.0	22	13	9	8	65	27	38	20	4>	1.6	X	2490
45.0		gv-u										10	68	22	37	37	2>	2.0	X	2170
47.0	47.5	gs	7	29	51	20	36.4	10.9	23	14	9									
50.0		gs										21	54	25	38	25	12>	1.5	2	2370
52.5	53.0	gs	9	31	45	24	51.1	11.7	25	12	13									
57.5	58.0	gs	5	29	46	25	37.8	12.5	26	13	13	21	53	26	35	30	15>	1.3	X	2510
62.0	62.5	gs	5	31	47	22	40.7	12.8	25	13	12									
67.5	68.5	gs	11	26	51	23	43.0	13.1	26	14	12									
72.0	72.5	gs-s	8	23	54	23	32.2	14.0	25	14	11									
78.5	79.0	gs-z	77	73	19	8	238.8	8.5	22	14	8									
80.1		gs-s										25	51	24	20	20	24>	1.4	3	2310
82.5	83.0	gs-s	3	17	61	22	23.3	17.4	29	16	13									
87.0	87.5	gs	18	40	43	17	99.5	12.5	23	14	9									
92.0	92.5	gs-s	2	16	57	27	22.8	18.3	28	16	12									
98.0	98.5	gs-s	3	16	58	26	26.0	19.5	27	16	11	31	43	26	0	0	26>	1.1	3	1070
102.5	103.0	gs-s	3	16	58	26	28.3	19.0	28	17	11									
107.0	107.5	gs-s	2	16	55	29	18.6	19.6	28	17	11									
114.5	115.0	gs	3	29	35	36	29.4	15.4	24	14	10									
115.0	115.5	gs	4	29	38	33	37.8	16.0	27	14	13									
117.3		ms-d										34	36	30	0	0	30>	0.8	0	2510
124.5	125.0	ms-z	3	93	4	3	2.5	20.0												
127.5	128.0	ms-z	22	95	3	2	3.4	22.5												
134.0	134.5	ms-z	44	70	20	10	156.8	15.2												
137.5	138.0	Pb	20	5	61	34	21.7	9.8	32	20	12	2	64	34	0	0	17>	1.2	X	5440

BOREHOLE # M-127
ELEVATION: 571.9 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.5	2.0	c	1	30	49	21	34.0	16.8	27	15	12									
6.0	6.5	c	0	5	82	13	28.7	21.1	23	14	9	62	24	14	0	0	39>	1.3	12	3780
11.5	12.0	c	9	95	2	3	2.5	29.1	27	16	11	59	27	14	0	0	33>	1.3	15	3080
14.7	15.2	c	7	90	6	4	4.0	19.6												
19.5	20.0	c	1	91	7	2	4.0	21.4				24	52	24	35	40	14>	1.5	4	2520
26.0	26.5	c	1	94	4	2	2.5	20.1												
33.3	33.8	c	1	82	14	4	7.5	23.7				10	59	31	60	30	5>	1.3	X	2250
38.5	39.0	gv-u	10	44	44	12	30.4	10.6	19	13	6	13	63	24	45	40	6>	1.8	X	2360
41.5	42.0	gm-z	3	60	35	5	14.8	14.5	19	12	7	7	60	33	37	30	3>	1.2	X	2090
46.5	47.0	gm-z	18	74	20	6	19.1	10.7												
47.9	48.0	gm-d	17	41	37	22	148.4	9.4	19	11	8	12	62	26	35	30	3>	1.6	X	2440
51.5	52.0	gs	8	28	48	24	40.8	10.6	25	13	12	24	50	26	40	20	16>	1.3	0	2170
56.5	57.0	gs	5	27	51	22	38.6	12.2	26	13	13	7	61	32	61	42	3>	1.3	X	2460
61.5	62.0	gs	5	28	52	20	38.6	12.6	26	13	13									
66.5	67.0	gs	11	28	51	21	49.5	11.9	26	13	13	10	54	36	60	35	7>	1.0	X	2280
71.5	72.0	gs	9	27	52	21	44.5	12.7	26	14	12									
75.5	76.0	gs-s	5	25	51	24	31.7	14.2	27	14	13	27	47	26	40	30	21>	1.2	2	2580
81.5	82.0	gs-s	2	15	61	24	24.1	18.5	31	16	15									
86.5	87.0	gs-s	2	19	57	24	24.4	19.0	30	17	13	25	48	27	31	30	18>	1.2	3	2630
92.0	92.5	gs-s	2	15	57	28	22.3	20.7	31	17	14									
96.5	97.0	gs-s	2	17	59	24	21.3	20.9	31	17	14	28	48	24	30	30	18>	1.3	6	2460
101.5	102.0	gs-s	4	18	57	25	25.6	19.6	28	16	12									
107.0	107.5	gs-s	1	9	61	30	14.2	31.8	40	22	18	31	45	24	38	41	18>	1.3	4	2960
111.5	112.0	gs-s	1	12	64	24	18.4	22.2	37	18	19									
119.0	119.5	ms-z	2	87	7	6	13.6	19.4				44	31	25	35	30	32>	0.8	5	3160
121.3	121.8	ms-z	1	82	16	2	10.4	15.5	28	15	13									
129.0	129.5	ms-z	21	77	15	8	56.9	11.6				40	34	26	0	0	29>	0.9	6	2980
130.1	130.6	ms-z	40	67	23	10	129.8	9.0	31	16	15	43	32	25	0	0	33.	0.8	7	3040

BOREHOLE # M-128

ELEVATION: 575.2 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
0.5	1.0	c	0	2	60	38	8.8	25.5	41	22	19									
2.5	3.0	c										62	24	14	0	0	39>	1.3	12	3780
6.0	6.5	c	0	30	47	23	35.0	21.5	27	16	11	59	27	14	0	0	33>	1.3	15	3080
12.3	12.8	c	0	80	15	5	43.6													
20.3	20.8	c										24	52	24	35	40	14>	1.5	4	2520
22.0	22.5	c	10	87	6	7	11.2													
29.6	30.1	gv-u										10	59	31	60	30	5>	1.3	X	2250
32.0	32.5	gv-u	6	47	33	20	116.0	8.9	20	12	8									
38.5	39.0	gv-u	13	44	39	17	134.6	10.4	19	12	7	7	60	33	37	30	3>	1.2	X	2090
42.5	43.0	gm-z	0	84	12	4	9.0													
47.5	48.0	gm-d	17	41	37	22	148.4	9.4	19	11	8									
47.6	48.1	gm-d										8	67	25	29	28	1>	1.8	X	2550
50.7	51.2	gm-d										7	61	32	61	42	3>	1.3	X	2460
53.2		gm-z	11	97	1	2	2.4													
53.2	53.7	gm-d										10	54	36	60	35	7>	1.0	X	2280
55.8	56.3	gm-z	1	97	1	2	2.2													
63.5	64.0	gs	4	29	48	23	33.1	11.9	24	13	11	27	47	26	40	30	21>	1.2	2	2580
67.5	68.0	gs	6	29	48	23	35.1	12.6	25	13	12									
69.3	69.8	gs										25	48	27	31	30	18>	1.2	3	2630
72.5	73.0	gs	6	27	51	22	36.2	13.3	25	14	11									
74.4	74.9	gs										28	48	24	30	30	18>	1.3	6	2460
77.0	77.5	gs-s	6	23	50	27	24.8	12.8	26	14	12									
79.4	79.9	gs-s										31	45	24	38	41	18>	1.3	4	2960
82.5	83.0	gs-s	3	22	52	26	23.5	14.5	26	14	12									
84.4	84.9	gs-s										44	31	25	35	30	32>	0.8	5	3160
87.5	88.0	gs-s	3	18	56	26	22.7	16.6	28	15	13									
89.4	89.9	gs-s										40	34	26	0	0	29>	0.9	6	2980
93.5	94.0	gs-s	1	17	57	26	21.1	18.2	31	16	15	43	32	25	0	0	33>	0.8	7	3040
98.0	98.5	gs-s	1	17	57	26	21.0	18.4	30	17	13									
99.3	99.8	gs-s										43	30	27	25	15	33>	0.7	4	2530
103.5	104.0	gs-s	1	19	55	26	20.2	19.5	30	16	14	36	34	30	0	0	29>	0.8	4	2380
107.0	107.5	gs-s	1	19	55	26	20.1	18.6	29	16	13									
109.4	109.9	gs-s										36	35	29	40	40	30>	0.8	5	2660
112.0	112.5	gs-s	5	18	55	27	23.7	18.9	30	16	14									
116.3	116.8	ps	0	0	65	35	13.2	22.0	35	19	16									
118.0	118.5	ps	0	10	52	38	15.8	17.7	31	16	15									
119.4	119.9	ps										13	50	37	0	0	22>	0.9	X	2870
121.0	121.5	ms-z	0	61	25	14	78.9													
123.5	124.0	ms-z	1	91	6	3	3.8													
129.2	129.7	Pb	1	3	40	57	4.9	9.4	37	20	17									

BOREHOLE # M-129
ELEVATION: 627.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
2.0	2.5	r	0	22	45	33	17.1	23.5	36	16	20	37	44	19	0	0	34>	1.6	4	1290
4.0	4.5	r	1	32	40	28	26.3	17.4	29	13	16									
8.5	9.0	b	3	40	28	32	73.6	18.5	32	14	18	53	29	18	0	0	34>	1.0	6	2380
12.0	12.5	gv-mx	11	44	34	22	125.2	9.7	22	12	10	34	49	17	45	35	25>	1.9	3	2340
16.5	17.0	gv-mo	9	42	34	24	106.6	9.7	23	12	11	23	56	21	50	40	13>	1.8	3	2140
23.5	24.0	gv-m	9	42	34	24	108.0	9.0	21	12	9	19	51	30	55	40	13>	1.1	0	2400
32.0	32.5	gv-u	8	40	36	24	93.9	9.5	23	12	11	19	51	30	60	35	14>	1.1	X	2520
37.0	37.5	gv-u	11	43	32	25	126.1	9.7	23	12	11	14	53	33	65	35	10>	1.1	X	2790
42.5	43.0	gv-u	11	40	33	27	100.8	9.9	24	12	12	18	50	32	57	43	15>	1.0	X	2830
48.0	48.5	gv-u	10	42	35	23	110.0	9.2	22	12	10									
53.5	54.0	gv-u	11	43	33	24	120.9	10.0	22	12	10									
58.0	58.5	gv-u	9	43	33	24	107.5	9.5	22	12	10	11	55	34	62	45	10>	1.1	X	2290
63.0	63.5	gv-u	8	43	37	20	94.0	10.4	21	12	9	13	53	34	60	40	10>	1.0	X	2510
68.0	68.5	gv-u	10	43	36	21	107.7	10.9	21	12	9	9	56	35	58	50	9>	1.1	X	2340
73.5	74.0	gv-u	8	45	38	17	104.5	10.1	20	13	7	13	58	29	42	37	8>	1.4	X	2520
78.5	79.0	gv-u	8	39	41	20	80.2	9.8	20	13	7	16	54	30	52	40	9>	1.2	0	2730
81.0	81.5	gv-u	7	35	43	22	61.4	11.3	22	14	8	19	51	30	40	38	14>	1.2	0	2560
86.0	86.5	gs	5	32	44	24	44.0	10.3	23	13	10	24	48	28	53	45	16>	1.1	0	2570
90.5	91.1	gs-s										27	44	29	37	22	22>	1.0	1	2250
93.5	94.0	gs-s	2	18	59	23	23.6	15.5	27	16	11	26	44	30	35	30	22>	1.0	0	2100
96.5	97.0	gs-s	3	19	56	25	25.4	18.2	30	16	14	27	37	36	30	0	25>	0.7	2	2600
101.0	101.5	gs-s	3	21	60	19	20.8	15.1	27	14	13	29	31	40	0	0	20>	0.5	X	1640
107.5	108.0	Pb	0	38	43	19	40.8	11.0	22	19	3	15	40	45	0	0	16>	0.6	X	1710

BOREHOLE # M-130

ELEVATION: 626.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP	DEP	UNIT	GVL	SD	ST	CL	Cu	W%	LL	PL	PI	EXP	ILL	C-K	CAL	DOL	VERM	DI	HSI	INT
TOP	BOT		%	%	%	%						%	%	%			IND			CPS
2.0	2.5	b	5	20	43	37	17.5	21.7	44	15	29	80	10	10	0	0	58>	0.7	14	5860
5.5	6.0	b	12	30	36	34	45.0	18.4	36	12	24	68	21	11	0	0	69>	1.2	15	7020
8.5	9.0	b	5	35	28	37	40.6	18.2	37	12	25	50	40	10	0	0	36>	2.6	11	3830
10.0	10.5	b	5	48	24	28	141.8	17.1	27	12	15									
13.2		pe										15	70	15	30	60	14>	1.8	X	1980
18.0	18.5	gv-z	1	95	2	3	2.2													
19.6	20.1	gv-u										9	61	30	96	60	1>	1.4	X	3380
21.5	22.0	gv-u	14	42	31	27	140.0	9.0	22	11	11									
26.0	26.5	gv-u	25	44	31	25	229.0	8.7	21	11	10	10	60	30	72	69	4>	1.3	1	3030
32.0	32.5	gv-u	21	43	32	25	181.6	8.5	22	11	11	8	56	36	92	56	5>	1.1	X	3090
38.0	38.5	gv-u	15	45	31	24	151.5	10.2	21	12	9									
41.0	41.5	gv-u	15	44	32	24	149.6	9.7	22	12	10	13	54	33	45	28	7>	1.1	X	2950
47.0	47.5	gv-u	25	44	31	25	237.5	10.1	22	12	10									
51.5	52.0	gv-u	21	44	34	22	202.2	9.1	21	12	9									
58.0	58.5	gv-u	16	45	32	23	147.5	8.3	20	11	9									
60.5	61.0	gv-u	19	43	35	22	170.6	8.5	20	12	8	13	57	30	53	27	8>	1.3	X	2640
64.0	64.5	gv-u	8	28	48	24	46.5	10.9	26	13	13									
68.5	69.0	gv-u	15	33	47	20	84.8	11.6	21	12	9	3	70	27	65	55	6>	1.8	X	3000
72.5	73.0	gv-u	18	38	40	22	128.3	10.4	20	12	8	9	62	29	32	25	6>	1.4	X	2350
77.0	77.5	gs	18	31	42	27	88.7	11.1	24	13	11	21	47	32	42	40	17>	1.0	X	2620
80.2	80.7	gs-s										28	43	29	48	50	22>	1.0	3	3600
98.0	98.5	gs-s										30	43	27	43	20	23>	1.0	3	4020
100.5	101.0	gs	4	28	51	21	36.5	14.7	23	15	8	17	51	32	32	22	14>	1.1	0	2410

BOREHOLE # M-131
ELEVATION: 632.1 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
DEP TOP	DEP BOT	UNIT	TOT GVL %	SD %	<2mm ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.0	1.5	p	0	20	52	28	12.6	24.1	28	21	7	47	29	24	0	0	36>	0.8	9	2420
4.1	4.6	r	0	20	42	38	11.5	23.9	42	12	30									
8.5	9.0	b	3	28	34	38	18.3	19.1	37	13	24	72	16	12	0	0	47>	0.9	6	3860
10.5	11.0	b	7	34	31	35	49.6	21.6	35	16	19	64	21	15	0	0	43>	1.0	4	4670
17.5	18.0	gv-m	10	44	30	26	139.2	8.4	19	10	9	10	63	27	71	57	3>	1.6	X	2960
23.7	24.2	gv-m	7	55	26	19	144.4	6.6	20	11	9	9	59	32	81	50	5>	1.2	X	2720
26.0	26.5	gv-m	5	43	33	24	97.8	7.4	17	11	6	9	62	29	80	53	3>	1.4	X	2760
33.5	34.0	gv-mz	6	90	5	5	3.9													
37.5	38.0	gv-u	8	42	30	28	106.1	8.2	21	11	10	13	57	30	63	50	7>	1.3	X	2900
43.5	44.0	gv-u	8	42	33	25	100.1	11.6	22	11	11	12	57	31	70	50	10>	1.2	X	2800
46.0	46.5	gv-u	6	44	28	28	97.6	10.6	22	12	10	11	57	32	65	37	7>	1.2	X	2770
53.5	54.0	gv-u	10	41	33	26	108.8	10.3	22	12	10	13	55	32	45	28	9>	1.1	X	2300
56.5	57.0	gv-u	9	32	41	27	55.4	12.0	24	12	12	11	56	33	60	32	10>	1.1	X	2540
62.5	63.0	gv-u	8	43	32	25	103.8	8.6	21	11	10									
68.5	69.0	gv-u	7	44	36	20	97.2	8.8	21	12	9	12	57	31	37	25	8>	1.2	X	1990
73.0	73.5	gv-u	12	42	37	21	119.6	8.8	20	11	9	14	56	30	60	30	7>	1.3	X	2280
76.0	76.5	gv-u	7	44	34	22	104.3	8.9	21	12	9	12	57	31	38	30	7>	1.2	X	2220
81.5	82.0	gv-u	9	36	40	24	73.8	9.9	22	13	9	15	57	28	37	30	7>	1.3	X	2480
87.0	87.5	gs	5	29	47	24	35.0	11.1	25	13	12	27	45	28	0	0	25>	1.1	0	2490
89.5	90.0	gs	5	29	45	26	39.2	11.8	26	13	13									
92.0	92.5	gs	6	29	49	22	39.1	11.6	25	14	11	30	45	25	35	30	20>	1.2	2	2670
97.0	97.5	gs	6	26	48	26	34.1	12.4	27	14	13	30	45	25	25	20	22>	1.2	3	1670
104.0	104.5	gs-s	3	22	53	25	27.6	13.1	27	15	12	33	42	25	30	28	23>	1.1	3	2420
106.0	106.5	gs-s	2	19	57	24	25.1	14.7	30	15	15	39	37	24	21	25	28>	1.0	3	2550
112.0	112.5	gs-s	2	18	56	26	24.4	15.4	29	15	14	35	39	25	37	25	22>	1.0	5	2680
118.0	118.5	gs-s	2	18	56	26	23.1	16.1	27	16	11	32	39	29	25	22	26>	0.9	1	2230
121.0	121.5	gs-s	2	19	59	22	23.1	18.4	28	16	12	20	45	35	35	35	21>	0.9	0	2660
124.0	124.5	gs-s	3	20	40	40	14.4	16.5	35	18	17									
125.0	125.5	gs-s	3	21	40	39	16.5	15.9	35	18	17									
127.0	127.5	Pb	0	8	70	22		9.9	29	18	11	2	57	41	38	25	14<	0.9	X	5610
129.0	129.5	Pb	0	28	57	15		14.8	24	21	3									

BOREHOLE # M-135
ELEVATION: 628.1 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION					ENGINEERING DATA				MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.1		p	1	12	56	32						41	34	25	0	0	28>	0.9	6	890
2.6		p	1	9	51	40		28.0	46	17	29									
3.6		p	0	14	55	31						82	11	7	0	0	49>	1.0	19	3530
5.1		r	0	25	37	38														
7.6		b	5	25	28	47						71	15	14	0	0	49>	0.8	3	2380
8.5		b	2	32	29	39		23.8	48	13	35									
10.1		b	2	36	24	40														
12.7		b	0	53	22	25						49	37	14	0	0	45>	1.8	2	2650
14.8		pe	3	90	6	4														
15.1		gv-mo	3	45	30	25						16	65	19	0	33	16>	2.3	1	1250
18.6		gv-m	10	44	29	27						14	56	30	60	38	11>	1.3	X	2350
27.8		gv-m										10	61	29	72	50	6>	1.4	X	2600
34.1		gv-u										10	61	29	90	43	5>	1.4	X	2830
37.5		gv-u	7	43	29	28						10	59	31	80	43	4>	1.3	X	2630
42.1		gv-u	5	48	28	24						10	59	31	62	45	2>	1.3	X	2270
46.1		gv-u	8	46	30	24		9.1	22	11	11									
46.6		gv-u	3	45	30	25						11	55	34	52	30	6>	1.1	X	2130
53.6		gv-u	2	44	31	25						12	56	32	42	38	7>	1.2	X	2300
56.6		gv-u	8	45	29	26						10	56	34	40	25	2>	1.1	X	2240
63.6		gv-u	4	44	31	25						10	56	34	50	40	2>	1.1	X	2260
66.4		gv-u	6	44	29	27		21.3	24	12	12									
67.6		gv-u	7	46	32	22						9	59	32	45	20	7>	1.2	X	1630
73.6		gv-u	11	46	30	24						12	57	31	37	32	8>	1.2	X	1915
77.6		gv-u	3	31	36	33						16	50	34	40	36	12>	1.0	X	2120
81.6		gv-u	5	45	31	24						10	59	31	50	35	5>	1.3	X	2130
89.1		gv-u	4	47	33	20						13	56	31	45	20	5>	1.2	X	1930
90.6		gv-u	34	40	40	20						11	56	33	40	30	10>	1.1	X	1650
90.7		gv-u										17	55	28	30	32	7>	1.3	X	1190
92.3		gm-z	69	94	3	3														
104.3		gm-d	30	55	26	19						8	72	20	115	97	6<	2.4	X	1250
106.6		gs	7	30	45	25						25	49	26	43	40	19>	1.2	1	2570

BOREHOLE #   CN-01
ELEVATION: 628.1 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
110.1		gs	6	32	38	30						23	50	27	25	30	13>	1.3	2	1730
115.9		gs	3	28	48	24		13.6	26	13	13									
120.1		gs-s	1	21	51	28						29	41	30	38	27	23>	0.9	2	2090
130.1		gs-s	1	22	50	28						20	52	28	20	15	18>	1.2	0	1570
140.1		gs-s	0	24	30	46						18	48	34	0	0	23>	0.9	X	2210
142.9		gs	3	35	35	30						7	48	45	0	0	11>	0.7	X	4970
150.1		gs-s	0	19	47	34						30	30	40	40	20	28>	0.5	X	1970
156.9		gs	4	46	22	32						14	60	26	42	32	8>	1.5	X	3680
157.5		ps	0	2	70	28														
162.1		ps	0	13	50	37						16	38	46	0	0	23>	0.6	X	1880
170.1		ps	0	1	82	17						17	55	28	30	20	14>	1.3	3	1630
174.3		ps	3	94	3	3														
174.5		ps	0	3	83	14						15	60	25	25	10	12>	1.6	X	1360
180.1		ms-d	31	59	24	17						13	51	36	80	40	3>	1.0	9	1690

BOREHOLE # CN-03
ELEVATION: 628.7 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
2.0		p	0	9	48	43		26.2	54	19	35									
8.4		r	1	32	27	41		20.9	46	14	32									
13.5		b	5	40	47	13		18.0	21	15	6									
15.0		gv-u	5	35	42	23		12.9	20	13	7									
15.5		gv-u										10	63	27	75	75	2>	1.6	X	2940
25.0		gv-u										9	62	29	78	50	1>	1.4	X	3010
35.0		gv-u										9	62	29	78	63	4>	1.4	X	3670
35.9		gv-z	20	88	3	9														
45.0		gv-u										9	59	32	73	56	5>	1.3	X	3040
55.0		gv-u										9	56	35	78	50	3>	1.0	X	2540
56.6		gv-u										10	59	31	78	60	5>	1.3	X	2860
60.9		gv-u	6	44	35	21		10.5	24	12	12									
65.5		gv-u										9	57	34	84	56	1>	1.1	X	2960
73.9		gv-u										10	56	34	58	40	8>	1.1	X	2240
83.0		gv-u	9	43	36	21		8.9	23	12	11									
85.1		gv-u										10	55	35	75	42	6>	1.0	X	2410
95.0		gv-u										11	56	33	62	30	10>	1.1	X	2150
101.2		gv-u	12	47	35	18		4.7	20	12	8									
105.3		gv-u										12	59	29	52	33	6>	1.4	X	2780
108.6		gv-u										18	54	28	55	47	14>	1.3	X	2770
114.9		gs-s										35	36	29	0	35	28>	0.8	0	2570
120.6		gs-s	1	17	55	28		19.2	31	16	15									
125.1		gs-s										32	31	37	0	0	28>	0.6	3	1920
135.0		gs-s										21	48	31	20	35	20>	1.0	0	1750
143.4		ms-d	1	42	34	24		15.3	23	12	11									

BOREHOLE # CLK-01-02
ELEVATION: 623 ft msl

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.0	1.7	p	1	10	64	26	1.6	24.0				40	35	25	0	0	31>	0.9	6	870
1.7	2.5	p					2.8	24.0												
3.5	4.2	p	0	6	54	41	3.1	27.0				68	20	12	0	0	40>	1.1	11	2280
4.2	5.0	p					2.2	24.0												
6.0	6.7	b	2	32	37	31	2.5	21.0												
6.7	7.5	b					1.6	21.0												
8.5	9.2	b	2	34	30	36	1.8	21.0				67	13	20	0	0	37>	0.4	2	1680
9.2	10.0	b					2.1	21.0												
11.0	11.7	b	2	41	31	29	2.5	19.0				53	32	15	0	0	41>	1.4	X	1720
11.7	12.5	b					1.8	18.0												
13.5	14.2	gv-mo	6	46	29	25	3.2	16.0				24	63	13	20	53	19>	3.2	3	1810
14.2	15.0	gv-mo					4.5	9.0				23	63	13	45	40	15>	3.2	1	1800
16.0	16.7	gs	1	32	44	24	4.5	9.0				35	34	31	0	0	29>	0.7	2	1330
16.7	17.5	gs					4.5	13.0				35	29	36	32	0	33>	0.5	2	1150
18.5	19.2	gs-s	11	22	52	25	4.5	13.0				32	32	36	0	0	28>	0.6	2	1330
19.2	20.0	gs					4.5	13.0												
21.0	21.7	ms-d	20	40	30	31	3.1	17.0				13	47	40	0	0	19>	0.8	X	900
21.7	22.5	ms-d	17	41	26	33	4.5	17.0				17	51	32	0	0	16>	1.1	X	1060
23.5	23.8	Pb						19.0												
23.8	24.2	Pb	0	75	13	12		14.0												
24.2	25.0	Pb	0	4	72	25		15.0				5	51	44	0	0	8>	0.8	X	3315
25.0	27.5	Pb	0	2	75	23		15.0				6	55	39	0	0	3>	1.0	X	2060

BOREHOLE # CLK-02-01
ELEVATION: 627 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.0	1.8	p	1	6	51	43	1.6	30.0				70	17	13	0	0	44>	0.8	15	3580
1.8	2.5	p	1	16	49	35	1.6	26.0				69	17	14	0	0	44>	0.8	11	2780
3.5	4.3	b	0	28	42	30	3.6	20.0				75	13	12	0	0	41>	0.8	6	3350
4.3	5.0	b	0	29	42	29	3.5	17.0				79	10	11	0	0	50>	0.6	7	4380
6.0	6.8	b	1	30	42	28	2.0	19.0				73	15	12	0	0	46>	0.8	9	4920
6.8	7.5	b	1	26	42	32	1.8	19.0				76	12	12	0	0	43>	0.7	7	4380
8.5	9.3	b	1	31	26	43	2.3	19.0				63	18	19	0	0	41>	0.6	9	2530
9.3	10.0	b	1	35	35	31	2.6	15.0				65	20	15	0	0	42>	0.9	7	2590
11.0	11.5	b	5	47	25	28	2.8	19.0				59	22	19	0	0	35>	0.8	3	1780
11.5	12.0	b	5	49	24	28	2.0	20.0				60	21	19	0	0	31>	0.7	2	1850
12.0	12.5	b	3	51	23	26	1.9	17.0				68	19	13	0	0	33>	1.0	4	3670
12.0	12.5	gv-mo	2	46	26	28	2.5	19.0				50	40	10	0	0	24>	2.8	5	3500
12.5	13.0	gv-mo					2.0	16.0												
13.0	13.5	gv-mo	5	47	30	23	1.5	25.0				28	59	13	0	0	8>	3.0	3	1070
16.0	17.1	gv-mo	4	44	31	25	4.5	9.0				14	68	18	60	40	7>	2.6	X	2250
17.3	17.5	gv-mo	5	45	31	24		10.0				14	71	15	65	55	3>	3.2	0	2420
18.5	19.5	gv-mo	5	44	36	20	4.5	8.0				13	69	18	60	60	6>	2.6	X	2390
19.5	20.0	gv-m					4.5	8.0				12	61	27	70	60	5>	1.5	X	2270
21.0	21.9	gv-z	18	90	6	4		12.0												
23.5	24.2	gv-u	6	40	40	20	4.5	9.0				10	62	28	60	55	1<	1.4	X	2400
24.2	25.0	gv-u	4	40	41	19	4.5	7.0				11	61	28	80	70	2>	1.4	X	3040
26.7	27.5	gv-u	11	51	31	18	4.5	9.0				9	67	24	48	30	<2	1.9	X	1660
28.5	29.2	gv-z	6	93	5	2		17.0												
31.0	31.7	gv-u	6	49	31	21		7.0				10	61	29	57	35	1>	1.4	X	1960
31.7	32.5	gv-u	4	44	32	24	4.5	7.0				12	61	27	58	37	3>	1.5	X	1960
34.2	35.0	gv-u	7	46	32	22	4.5	8.0				15	56	29	50	35	9>	1.3	X	2020
36.0	36.7	gv-u	10	45	33	22	4.5	9.0				11	59	30	53	34	1>	1.3	X	2240
38.5	39.2	gv-u	8	45	33	23	4.5	10.0				11	61	28	47	30	2<	1.4	X	1680
39.2	40.0	gv-u	7	45	32	23	4.5	7.0				8	64	28	48	30	2<	1.5	X	1870
41.0	41.7	gv-u	5	44	35	22	4.5	9.0				13	55	32	60	40	6>	1.2	X	2970
41.7	42.5	gv-u	7	43	35	22	4.5	9.0				12	58	30	58	30	3>	1.3	X	2800
43.5	44.2	gv-u	7	44	33	23	4.5	10.0												
44.2	45.0	gv-u	8	44	33	24	4.5	10.0				13	53	34	70	20	6>	1.1	X	2480
46.0	46.7	gv-u	6	44	34	22	4.5	11.0				11	57	32	40	20	2>	1.2	X	2090
46.7	47.5	gv-u	15	46	32	22	4.5	11.0				14	54	32	30	25	6>	1.1	X	1840
48.5	49.2	gv-u	9	40	37	23	4.5	11.0				7	60	33	40	30	6>	1.2	X	2920
49.2	50.0	gv-u	19	29	38	33	4.5	14.0				5	63	32	40	32	8>	1.3	X	3740
51.0	51.7	gv-u	5	46	33	21	4.5	10.0				13	55	32	55	40	7>	1.2	X	2380

BOREHOLE # CLK-02-01
ELEVATION: 627 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
53.5	54.2	gv-u	41	17	51	32	4.5	9.0				15	53	32	72	47	9>	1.1	X	2370
58.5	59.2	gv-u	6	45	32	23	4.5	9.0				15	54	31	60	40	10>	1.2	X	2450
63.5	64.2	gv-u	6	43	37	20	4.5	9.0				14	56	30	54	48	8>	1.2	X	2650
68.5	69.2	gv-u	7	44	35	22	4.5	9.0				15	53	32	60	40	13>	1.1	X	2665
73.5	74.2	gv-u	10	43	38	19	4.5	10.0				15	58	27	55	48	6>	1.4	X	2620
78.5	79.2	gv-u	8	45	36	18	4.5	9.0				14	55	31	46	40	9>	1.2	X	2720
83.5	84.2	gs	8	35	45	20	4.5	12.0				23	49	28	30	28	17>	1.2	X	2880
88.5	89.2	gs	9	37	41	22	4.5	9.0				25	47	28	33	20	17>	1.1	X	2680
98.5	99.2	gs	12	36	46	18		10.0				34	43	23	18	18	22>	1.2	2	3200

BOREHOLE # CLK-02-02
ELEVATION: 623 ft msl

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.0	1.7	p	0	6	66	28	1.5	23.0				35	36	29	0	0	37>	0.8	3	1930
1.7	2.5	p	0	5	62	33	1.8	26.0				44	32	24	0	0	38>	0.9	5	1645
3.5	4.2	r	2	29	39	32	3.8	19.0				87	6	7	0	0	59>	0.6	13	6450
4.2	5.0	r	1	25	42	34	2.6	25.0				74	15	11	0	0	51>	0.9	7	4060
6.0	6.7	b	3	33	32	35	3.8	19.0				89	6	5	0	0	67>	0.9	18	7890
6.7	7.5	b	2	41	25	34	3.6	20.0				86	7	7	0	0	62>	0.7	28	5505
8.5	9.2	b	4	47	24	30	2.3	17.0				80	14	6	0	0	34>	1.6	25	4755
9.2	10.0	b	5	46	24	30	2.0	18.0				45	39	16	0	0	20>	1.7	10	1520
11.0	11.2	gv-mo	5	44	31	25	2.1	14.0				25	63	12	0	20	15>	3.6	0	3220
11.7	12.5	gv-mo	6	43	30	26	4.5	10.0				18	65	17	60	45	12>	2.6	X	2170
13.5	14.2	gv-mo	7	47	31	22	4.5	8.0				13	67	20	100	60	9>	2.3	X	2225
14.2	15.0	gv-mo					4.5	8.0												
16.0	16.7	gv-mo	5	41	31	29	4.5	12.0				12	70	18	90	50	2>	2.6	0	2900
16.7	17.5	gv-m					4.5	7.0												
18.5	19.2	gv-m	5	44	32	24	4.5	8.0				10	64	26	95	50	5>	1.6	X	3860
19.2	20.0	gv-m					4.5	7.0												
21.0	21.7	gv-m	6	44	32	24	4.5	9.0				11	61	28	100	55	1>	1.4	X	3860
21.7	22.5	gv-m					4.5	8.0												
23.5	24.2	gv-m	7	45	30	25	4.5	10.0				11	63	27	80	58	3>	1.6	X	3740
24.2	25.0	gv-m	4	65	21	14		12.0												
26.0	26.7	gv-m	9	46	32	23	4.5	9.0				10	63	27	85	50	1>	1.6		3440
28.5	29.2	gv-u	5	43	33	24	4.5	9.0				6	61	33	95	60	4<	1.2	X	3620
31.7	32.5	gv-u	4	36	38	26	4.5	13.0				21	49	30	47	37	16>	1.1	X	3580
33.5	34.2	gv-u	6	45	33	23	4.5	12.0				19	51	30	65	47	11>	1.1	X	4290
36.0	36.7	gv-u	5	44	34	23	4.5	11.0				9	55	36	80	55	2>	1.0	X	3200
38.5	39.2	gv-u	5	45	32	24	4.5	11.0				11	56	33	68	40	6>	1.2	X	3620
41.0	41.7	gv-u	8	44	40	16	4.3	12.0				13	53	34	78	50	7>	1.1	X	3130
43.5	44.2	gv-u	5	45	33	22	4.5	9.0				10	55	35	60	40	2>	1.1	X	3120
46.0	46.7	gv-u	9	46	33	21	4.5	11.0				11	53	36	80	45	8>	1.0	X	2850
48.5	49.2	gv-u	6	45	36	19	4.5	11.0				13	54	33	55	40	6>	1.2	X	2990
51.7	52.5	gv-u	6	46	33	21	4.5	10.0				12	57	31	60	40	7>	1.3	X	3290
54.2	55.0	gv-u	7	45	33	22	4.5	10.0				13	57	30	52	34	2>	1.3	X	2140
56.7	57.5	gv-u	8	45	34	21	4.5	10.0				11	57	32	45	25	5>	1.2	X	2330
59.2	60.0	gv-u	9	44	36	20	4.5	9.0				14	56	30	43	35	6>	1.3	X	2400
61.7	62.5	gv-u	8	43	35	22	4.5	10.0				12	58	30	50	37	6>	1.3	X	2300
64.2	65.0	gv-u	7	45	35	21	4.5	10.0				12	58	30	50	30	4>	1.3	X	2380
66.0	66.7	gv-u	4	45	34	21	4.5	9.0				14	55	31	50	40	7>	1.2	X	2180
68.5	69.2	gm-z	1	85	11	4	4.5	10.0												
69.2	70.0	gm-d	11	48	30	22	4.5	8.0				13	57	30	45	30	5>	1.3	X	2310

BOREHOLE #   CLK-02-02
ELEVATION: 623 ft msl

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
71.0	71.7	gm-z	26	84	12	4	4.5	10.0												
74.2	75.0	gm-z	37	92	6	2		14.0												
76.7	77.5	gm-d	24	96	3	1		14.0												
79.2	80.0	gm-z	41	93	5	2		14.0												
81.7	82.5	gm-z	66	90	7	3		14.0												
83.5	84.2	gm-z	5	48	41	11		17.0												
84.2	85.0	gm-z	35	93	5	2		13.0												
86.0	86.7	gs	3	29	49	23	4.5	14.0				25	51	24	37	25	17>	1.4	3	2610
88.5	89.2	gs	6	28	50	22	4.0	14.0				30	48	22	30	40	19>	1.5	2	3420
93.5	94.2	gs	3	30	54	16	4.5	13.0				34	46	20	42	35	22>	1.5	0	2670
98.5	100.0	gs																		
103.5	104.2	gs	2	26	54	21	4.5	14.0				41	37	22	20	18	28>	1.1	2	2670
108.5	109.2	gs-s	4	21	57	23	4.5	17.0				38	39	23	23	25	30>	1.1	3	2670
109.2	110.0	gs-s	2	19	64	17	4.5	17.0				37	37	26	22	25	29>	1.0	2	2560
114.2	115.0	gs-s	1	19	62	19	4.5	17.0				40	38	22	22	25	30>	1.2	2	2380
118.5	119.2	gs-s	4	22	56	22	4.5	17.0												
123.5	124.2	gs-s	2	21	64	15	4.5	18.0				30	44	26	30	28	25>	1.1	2	2370
128.5	129.2	gs-s	5	20	61	19	4.5	17.0				36	40	24	26	20	27>	1.1	0	2240
133.5	134.2	gs-s	4	17	62	22	4.5	16.0												
134.2	135.0	gs-s	2	15	67	18	3.0	21.0				34	37	29	0	25	32>	0.8	0	2370
134.2	135.0	gs-s										6	53	41	0	0	15>	0.9	X	4050
138.5	139.2	gs	24	27	43	31	4.5	9.0				16	60	24	25	35	7>	1.7	X	2160
139.2	140.0	ps	0	3	85	12	4.5	26.0				26	44	30	0	0	24>	1.0	4	1370
143.5	144.2	ps	2	18	58	24	4.5	20.0				24	41	35	0	0	24>	0.8	1	2000
148.5	149.2	ms-s	0	2	22	76	4.0	23.0				2	77	21	26	0	8<	2.4	X	4190
148.5	149.2	ms-s										6	85	9	0	0	5<	6.0	X	2560
149.2	150.0	ms-s	1	29	45	23	4.5	16.0				15	56	29	0	0	12>	1.3	X	2960
153.5	154.2	ms-s	0	9	77	15	2.6	21.0				17	55	28	35	37	15>	1.3	X	2170
158.5	159.2	ms-z	17	88	10	2		15.0												
163.5	164.2	ms-z	45	87	9	3		14.0												
169.2	170.0	ms-z	1	92	7	1		35.0												
173.5	174.2	ms-z	0	92	8	0		24.0												
174.2	175.0	ms-d	7	30	47	5		23.1				31	39	30	28	0	10>	0.9	12	1530
178.5	179.2	ms-z	1	84	11	23		22.0				15	44	41	38	0	18>	0.7	X	3970
183.5	184.2	Pb	4	21	45	34	4.0	17.0				14	43	43	0	0	18>	0.7	X	3600
184.2	185.0	Pb					3.4	18.0												

BOREHOLE # CLK-02-03

ELEVATION: 632 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.0	1.7	p					2.8	24.0												
1.7	2.5	p	0	9	55	36	3.5	19.0				39	44	17	0	0	26>	1.7	4	2205
3.5	4.2	p	1	6	51	43	2.0	28.0				50	37	13	0	0	35>	1.9	6	3400
4.2	5.0	p	1	4	63	33	1.5	26.0				56	33	11	0	0	35>	1.9	9	3950
6.0	6.7	r	0	28	42	30	1.0	20.0				62	21	17	0	0	49>	0.8	6	2900
6.7	7.5	r	2	28	42	30	1.0	21.0				66	17	17	0	0	50>	0.7	9	3030
8.5	9.2	b	4	35	35	31	4.5	22.0				47	30	23	0	0	55>	0.8	9	2820
9.2	10.0	b	3	30	34	37	1.5	20.0				54	26	20	0	0	56>	0.8	9	3200
11.0	11.7	b	5	36	30	34	1.5	21.0				61	21	18	0	0	51>	0.8	14	3090
11.7	12.5	b	1	38	28	35	1.5	20.0				40	39	21	0	0	38>	1.2	5	2480
13.5	14.2	gv-mo	8	44	32	24	4.5	10.0				19	65	16	50	35	5>	2.8	3	2150
14.2	15.0	gv-mo	6	45	34	22	4.0	8.0				15	64	21	40	40	7>	2.1	3	1820
16.0	16.7	gv-m	5	44	32	24	4.5	9.0				11	61	28	50	35	0	1.5	X	2110
18.5	19.2	gv-m					4.5	8.0				11	61	28	42	32	4>	1.5	X	2250
21.0	21.7	gv-u	5	45	32	23	4.5	8.0				8	61	31	65	36	2>	1.3	X	2720
23.5	25.0	gv-u																		
26.0	26.7	gv-u	3	43	35	22	4.5	9.0				12	58	30	20	35	2>	1.3	X	2120
28.5	29.2	gv-u	6	45	32	23	4.5	9.0				11	59	30	25	43	0	1.3	X	2390
31.5	32.5	gv-u	7	44	34	22	4.5	9.0				9	59	32	20	50	2>	1.2	X	2440
33.5	35.0	gv-u	7	45	31	23	4.5	10.0				7	61	32	30	40	7>	1.2	X	2520
36.0	37.5	gv-u	5	46	32	22	4.5	10.0				7	63	30	25	50	3>	1.4	X	2200
39.2	40.0	gv-u	7	44	34	23	2.5	12.0				10	59	31	30	42	0	1.2	X	2325
41.0	41.7	gv-u	11	45	35	20	2.0	12.0				9	57	34	10	35	0	1.1	X	2250
42.5	43.2	gv-u	4	45	32	23	3.3	12.0				9	59	32	20	40	2>	1.2	X	2610
46.0	46.7	gv-u	5	41	36	23	1.5	13.0				9	58	33	15	30	0	1.2	X	2180
48.5	49.2	gv-u	6	43	35	22	4.5	12.0				10	54	36	30	32	2>	1.0	X	1825
51.0	51.7	gv-u	8	44	33	23	4.5	11.0				12	57	31	45	37	1>	1.2	X	3000
53.5	54.2	gv-u	8	44	33	23	4.5	12.0				7	59	34	50	44	2>	1.2	X	2540
56.0	56.7	gv-u	11	43	34	23	4.5	11.0				10	58	32	58	37	3>	1.2	X	2540
58.5	59.2	gv-u	7	42	35	24	2.5	13.0				14	56	30	37	32	5>	1.2	X	2700
61.0	61.7	gv-u	9	43	35	22	3.3	11.0				8	58	34	63	41	0	1.1	X	2750
63.5	64.2	gv-u	8	44	34	23	4.5	12.0				10	57	33	48	35	2>	1.1	X	3010
66.0	66.7	gv-u	8	44	31	24	3.5	11.0				7	61	32	59	43	3>	1.3	X	2775
68.5	69.2	gv-u	4	46	32	22	4.5	9.0				10	58	32	57	40	1>	1.2	X	2720
71.0	71.6	gv-u	22	44	33	23	4.5	10.0				12	55	33	42	33	3>	1.1	X	2855
73.5	74.2	gv-u	28	44	35	21	4.5	11.0				11	58	31	50	33	4>	1.2	X	3010
76.0	76.7	gv-u	6	43	34	22	4.5	12.0				11	57	32	52	37	5>	1.2	X	2960
78.5	79.2	gv-u	5	44	35	21	4.5	11.0												
81.0	81.7	gv-u	6	44	36	21	4.5	11.0				10	57	33	42	28	2>	1.2	X	2830

OUTCROP # CLK-02-03
ELEVATION: 632 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
83.5	84.2	gv-u	5	45	33	23	4.5	10.0				9	59	32	73	46	2>	1.2	X	2400
88.5	89.2	gv-u	14	45	35	20	4.5	10.0				12	53	35	40	29	7>	1.0	X	2700
91.0	91.6	gv-u	7	45	34	21	4.5	9.0				14	53	33	56	30	8>	1.1	X	2490
93.5	94.2	gv-u	6	45	35	21	4.5	10.0				12	57	31	41	30	6>	1.2	X	2690
96.7	97.5	gv-u	7	44	37	20	4.5	10.0				10	55	35	60	42	4>	1.1	X	3090
98.5	99.2	gv-u	23	44	36	21	4.5	10.0				13	55	32	52	38	6>	1.1	X	3020
104.2	105.0	gv-u	9	44	35	21	4.5	12.0				15	57	28	50	30	9>	1.3	X	2470
108.5	109.2	gv-u	6	44	37	19	4.5	11.0				11	58	31	50	30	5>	1.1	X	2510
113.5	114.2	gv-u	7	42	38	20	4.5	11.0				15	53	32	45	32	9>	1.1	X	2430
118.5	119.2	gv-u	6	44	37	19	4.5	11.0				14	59	27	63	40	11>	1.5	X	2400
123.5	124.2	gv-u	18	37	42	20	4.5	11.0				16	60	24	30	30	5>	1.7	X	3080
128.5	129.2	gv-u	5	44	38	18	4.5	10.0				14	57	29	35	32	7>	1.3	X	2520
133.5	134.2	gv-u	11	49	33	18	4.5	10.0				15	56	29	37	35	11>	1.3	X	2580
134.2	135.2	gm-z	15	66	24	10		10.0				15	56	29	37	35	11>	1.3	X	2580
138.5	139.2	gm-z	9	61	27	13		12.0				14	56	30	75	46	6>	1.3	X	2240
141.0	141.7	gm-d	5	42	40	19	2.1	14.0												
143.5	144.2	gm-d					1.8	14.0				9	61	30	50	40	3>	1.4	X	2540
144.2	145.0	gm-d	10	43	41	16	2.5	11.0				15	54	31	51	40	5>	1.2	X	2710
148.5	149.2	gm-d	8	48	38	15	3.2	12.0				13	56	31	50	37	7>	1.3	X	3190
153.5	154.2	gm-z	10	71	22	7		14.0												
158.5	159.2	Pb	9	41	42	18	3.4	13.0				16	49	35	31	34	13>	1.4	X	3520
163.5	164.2	Pb	8	42	40	18		14.0												
168.5	169.2	Pb						22.0												
173.5	174.2	Pb	1	19	56	25		15.0				21	44	35	26	0	22>	0.8	X	2925

BOREHOLE #   CLK-03-01
ELEVATION: 600 ft msl

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
71.0	71.7	ms-s	0	10	77	13	3.5	19.0												
73.5	74.2	ms-z	20	66	23	11		17.0												
74.2	75.0	Pb	3	29	48	24	3.8	16.0				21	44	35	0	32	20>	0.8	X	1920
78.5	79.2	Pb	2	27	47	26	3.8	16.0				19	40	41	0	30	21>	0.7	X	1720
83.5	84.2	Pb	0	41	37	22	4.5	17.0				18	36	46	0	30	23>	0.5	X	1520
88.5	89.2	Pb	2	64	20	16	4.5	26.0				16	60	24	0	0	15>	1.7	0	850

OUTCROP # CC-5
ELEVATION: 620 ft msl

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.4	1.5	b	5	44	23	33						46	36	18	0	0	37>	1.3	5	1475
2.9	3.0	gv-mx	4	46	24	31						28	59	13	0	0	21>	2.9	5	1790
5.9	6.0	gv-uo	5	46	28	26						17	68	15	62	40	8>	3.1	4	1930
8.9	9.0	gv-u	6	45	31	24						19	59	22	58	45	16>	1.7	0	2660
11.9	12.0	gv-u	7	45	32	23						18	56	26	55	42	12>	1.5	1	2330
13.9	14.0	gv-u	8	44	33	23						14	56	30	35	35	8>	1.2	0	1980
14.9	15.0	gv-u	7	44	34	21						15	56	29	41	36	8>	1.3	0	2020
16.9	17.0	gv-u	7	45	33	22						11	60	29	67	54	1>	1.4	X	2390
19.9	20.0	gv-u	7	46	30	23						11	59	30	52	40	3>	1.3	X	2640

UTCROP #   CC-8
LEVATION: 570 ft

DEP TOP	DEP BOT	UNIT	TOT GVL %	SD %	<2mm ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
AMPLE DENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
2.9	3.0	gv-uo	3	45	31	24						18	66	16	68	35	14>	2.8	X	2040
4.4	4.5	gv-uo	12	45	31	24						10	69	21	50	30	6>	2.3	X	1950
5.9	6.0	gv-uo	4	42	37	21						33	52	15	37	30	25>	2.3	4	2360
6.2	6.3	gs-s	1	18	58	24						45	38	17	0	0	37>	1.5	7	3090
7.4	7.5	gs-s	2	17	62	21						47	37	16	0	0	37>	1.5	7	3200
9.9	10.0	gs-o	4	33	48	19						42	41	17	0	35	37>	1.6	5	2590
10.0	10.1	ps-o	0	2	75	23						39	45	16	0	0	32>	1.8	9	3050
11.4	11.5	ps-o	0	4	73	23						50	33	17	0	0	24>	1.3	8	2100
11.9	12.0	ps-o	0	5	72	22														
12.4	12.5	bl	0	7	70	22						37	39	24	0	0	34>	1.1	8	2020
13.4	13.5	bl	1	17	58	25						53	26	21	0	0	38>	0.8	9	2850
13.9	14.0	bl	0	21	52	27						47	31	22	0	0	29>	1.0	4	2770
15.4	15.5	bl	0	32	39	29						48	30	22	0	0	28>	0.9	6	2810
16.9	17.0	bl	2	31	34	35						43	29	28	0	0	30>	0.7	7	2370
18.4	18.5	bl	1	34	28	38						44	31	25	0	0	37>	0.8	6	2720
18.9	19.0	bl	2	34	28	38						60	23	17	0	0	48>	0.9	8	3330
19.9	20.0	bl	1	43	30	27						57	28	15	0	0	45>	1.3	9	4040
20.9	21.0	bl	35	54	29	17						13	59	28	0	0	8>	1.4	X	1780
21.4	21.5	bc	9	46	32	23						20	58	22	70	34	12>	1.8	X	2730

OUTCROP # CC-11
ELEVATION: 580 ft msl

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP	DEP	UNIT	GVL	SD	ST	CL	Qu	W%	LL	PL	PI	EXP	ILL	C-K	CAL	DOL	VERM	DI	HSI	INT
TOP	BOT		%	%	%	%						%	%	%			IND			CPS
	1.0	gv-uo	5	52	26	21						28	61	11	20	30	22>	2.9	3	2620
	2.5	gv-uo	14	51	26	24						28	57	15	37	30	21>	2.4	3	1800
	4.0	gv-uo	4	52	27	21						21	64	15	43	41	20>	2.9	2	1490
	5.5	gv-uo	8	43	30	27						22	58	20	43	28	23>	1.9	2	1870
	5.5	gv-u	8	43	30	27						22	58	20	43	28	23>	1.9	2	1870
	7.0	gv-uo	3	49	30	21						19	64	17	55	31	16>	2.6	1	1690
	8.5	gv-uo	5	44	36	20						29	54	17	50	30	18>	2.1	3	1890
	9.0	gv-uo	6	42	36	22						27	58	15	40	28	10>	2.7	3	1650
	9.5	gs-s	0	15	60	25						46	37	17	20	25	31>	1.4	2	1310
	10.0	bl	1	28	39	34						43	32	25	0	0	40>	0.9	2	1610
	11.5	bl	5	25	26	48						46	25	29	0	0	29>	0.6	2	1190
	13.0	bl										49	25	26	0	0	30>	0.6	2	1220
	14.5	bc-x	3	41	32	27						28	54	18	20	0	16>	2.0	2	1770
	16.0	bc-o	8	44	37	19						19	58	23	42	20	15>	1.7	1	1560
	17.5	bc-o	6	44	37	19						19	62	19	63	25	13>	2.2	2	1790
	19.0	bc-o	11	49	32	19						18	55	27	30	0	9>	1.4	X	1640
	20.5	bc-o	38	56	28	16						18	52	30	40	0	13>	1.2	0	1740
	22.0	bc-o	5	44	37	19						20	59	21	55	30	14>	1.9	3	1730
	25.0	bc-o	7	43	38	19						25	58	17	50	25	18>	2.3	2	1770
	27.0	bc										6	65	29	53	18	6>	1.5	X	2160

OUTCROP # CC-15
ELEVATION: 625 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
2.2	2.3	p										52	29	19	0	0	37>	1.0	5	3100
2.4	2.5	r										64	20	16	0	0	43>	0.9	6	4500
2.9	3.0	b										61	29	10	0	0	48>	1.7	10	6940
3.9	4.0	b										70	15	8	0	0	52>	1.2	12	7230
4.9	5.0	b										81	13	6	0	0	59>	1.4	13	6010
5.9	6.0	gv-mx										37	49	14	0	0	24>	2.4	5	2430
6.9	7.0	gv-x																		
7.9	8.0	gv-mx										32	55	13	0	0	22>	2.0	10	4120
8.9	9.0	gv-mo										26	59	15	81	85	17>	2.7	3	3390
9.9	10.0	gv-mo										20	63	17	58	40	15>	2.5	3	1480
10.9	11.0	gv-mo										22	60	19	52	40	12>	2.1	3	1610
11.9	12.0	gv-mo										26	58	16	55	35	20>	2.5	3	1640
12.3	13.0	gv-mo										22	57	21	50	40	16>	1.8	3	2010
13.9	14.0	gv-m										18	56	26	55	43	17>	1.4	2	2780
14.9	15.0	gv-u	0	38	34	28						18	51	31	55	45	12	1.1	X	2800
16.9	17.0	gv-u										13	55	32	50	35	7>	1.1	X	2420
18.9	19.0	gv-u	5	49	29	22						13	53	34	58	40	9>	1.0	X	2660

OUTCROP # CC-16
ELEVATION: 620 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
0.1		p	0	21	57	22						27	37	36	0	0	32>	0.7	1	730
0.5		p	0	14	54	32						35	35	30	0	0	38>	0.8	2	1130
0.9		p	0	8	45	47						38	33	29	0	0	37>	0.8	4	1370
2.0		p	0	7	46	48						48	30	22	0	0	38>	0.9	4	1710
2.6		r	0	28	37	35						54	29	17	0	0	41>	1.1	7	1860
3.1		r	0	31	37	32						53	24	23	0	0	44>	0.7	6	1740
3.5		b	5	38	33	29						83	11	6	0	0	45>	1.1	21	3380
4.3		b	8	59	15	27						83	11	6	0	0	54>	1.4	27	6020
4.9		pe	0	77	6	18						57	28	15	0	0	45>	1.3	9	2385
6.0		pe	5	78	8	14						59	31	10	0	0	45>	2.1	11	3240
9.0		pe	1	14	32	54						52	41	7	0	0	38>	3.8	18	3680
9.5		gv-mo	5	46	29	25						27	59	14	207	227	21>	2.8	4	1870
10.0		gv-mo	3	46	30	24						17	68	15	60	45	12>	3.0	0	1770
10.1		gv-m	4	44	33	23						18	67	15	38	33	12>	2.9	0	1700
11.6		gv-m	9	43	36	21						16	69	15	47	40	11>	3.1	X	1975
18.6		gv-u	0	14	76	10						17	71	12	50	47	9>	3.9	X	1980
19.6		gv-u	6	41	37	22						9	64	27	52	49	1<	1.6	X	3040

OUTCROP # CC-17
ELEVATION: 600 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
0.2	0.3	c	0	30	48	22						26	55	19	0	0	13>	1.9	3	980
0.5	0.6	c	1	28	46	26						24	56	20	0	0	11>	1.8	3	675
0.6	0.7	c	0	28	45	27						48	46	26	0	0	21>	1.2	4	990
0.7	0.9	c	0	23	44	33						41	36	23	0	0	32>	1.1	5	1330
0.9	1.0	c	1	17	37	46						69	20	11	0	0	41>	1.2	15	3130
2.3	2.5	c	0	19	55	26						53	29	18	0	0	39>	1.1	8	2380
3.3	3.4	c	1	14	45	41						79	14	7	0	0	46>	1.4	22	5200
4.3	4.4	c	0	5	51	44						73	18	9	0	0	37>	1.4	24	3780
5.6	5.7	c	3	38	32	30						70	22	8	0	0	33>	1.9	20	3410
7.2	7.4	c	0	3	63	34						64	24	12	0	0	33>	1.3	14	3160

OUTCROP # CC-18
ELEVATION: 584 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
1.0		c	0	5	63	32						34	40	26	0	0	18>	1.0	4	890
2.0		c	0	6	60	35						31	48	21	0	0	20>	1.5	4	810
4.0		c	0	6	63	31						32	47	21	0	0	19>	1.5	4	770

OUTCROP # CC-19

ELEVATION: 605 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
0.5		pey	2	32	37	32						38	43	19	0	0	30>	1.5	3	840
1.0		pey	5	24	41	35						48	35	17	0	0	34>	1.3	8	1085
1.5		pey	6	33	38	29						51	31	18	0	0	33>	1.1	7	1080
2.5		b	5	51	27	23						38	43	19	0	0	37>	1.5	5	1050
4.5		gv-mo	10	53	22	26						36	51	12	0	0	34>	2.8	4	1290

OUTCROP # CC-20
ELEVATION: 655 FT

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
DEP TOP	DEP BOT	UNIT	TOT GVL %	SD %	<2mm ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
2.0		p		10	54	36						69	16	15	0	0		0.8		950
4.0		r		24	47	29						80	11	9	0	0		0.9		1710
6.0		b		27	32	41						64	27	9	0	0		1.9		1170
8.0		gv-mo		38	32	30						13	80	7	0	0		7.3		1950
10.0		gv-mo		39	36	25						16	67	17	21	35		5.6		1300
12.0		gv-uo										15	67	15	47	34	0	2.9		880
14.0		gv-u										13	61	26	32	20	0	1.6		890
16.0		gs-s		25	51	24						38	43	21	14	13		1.4		980
18.0		gs-s										36	42	22	15	14		1.3		950
20.0		bc-o		24	44	32						15	58	27	18	7		1.4		1260
22.0		bc-o										15	59	26	27	14		1.5		1170
24.0		bc										12	60	28	25	11		1.4		1640
26.0		bc										12	57	31	25	13		1.2		1050
28.0		bc										12	57	31	26	8		1.3		1300
30.0		bc		25	44	31						11	58	31	25	11		1.2		1350
32.0		bc										8	56	36	17	11		1.1		1860
34.0		bc										6	60	34	14	9		1.2		1360
36.0		bc										7	58	35	13	9		1.1		1210

OUTCROP WHJ48 (KETTLES, 1980)
ELEVATION: 649 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
	14.8	gv-uo		39	33	28						15	74	11	24	18		4.4		
	16.7	gv-uo		35	35	30						17	72	11	29	21		4.1		
	21.0	gv-u		37	34	29						13	64	23	27	23		1.9		
	23.0	gs-s		19	53	28						44	39	17	6	12		1.6		
	25.0	gs-s		18	54	28						44	40	16	6	7		1.7		
	27.0	bc-o		31	39	30						25	57	18	21	16		2.1		
	31.8	bc-o		29	40	31						16	64	20	21	11		2.1		
	34.8	bc-o		25	38	37						18	67	15	30	13		3.1		
	36.7	bc-o		32	42	26						23	66	11	29	13		4.1		
	39.1	bc-o		29	43	28						21	65	14	33	18		3.1		
	41.0	bc-o		28	40	26						16	69	15	32	12		3.0		
	44.0	bc-o										14	68	18	22	8		2.5		
	50.0	bc-o		30	42	29						10	69	21	43	18		2.2		
	53.8	bc		31	42	27						9	64	27	31	15		1.6		
	56.8	bc		26	48	26						11	65	24	25	15		1.8		

OUTCROP #   CLARKSVILLE SECTION (KETTLES, 1980)

ELEVATION: 694 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Qu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
3.3	gv-mx			47	22	31						38	52	10				3.5		
4.6	gv-mo			48	28	24						23	67	10	21	12		4.2		
5.9	gv-mo			41	30	29						25	65	10	41	30		4.3		
7.2	gv-mo			42	28	30						18	67	15	34	58		2.9		
8.5	gv-mo			42	32	26														
9.8	gv-mo			41	30	29						15	72	13	37	27		3.7		
11.2	gv-mo			42	30	28						13	71	16	36	25		3.0		
12.5	gv-mo			42	30	28														
13.8	gv-mo			41	32	27						16	72	12	32	24		4.0		
15.1	gv-mo			41	25	31						19	67	14	38	26		3.2		
16.4	gv-mo			46	31	23						21	66	13	40	24		3.3		
17.7	gv-mo			55	27	26						17	67	16	38	25		2.7		
19.0	gv-mo			43	33	22						19	68	13	36	27		3.5		
19.7	gs-o			36	40	24						38	49	13	17	22		2.4		
21.7	gs-o			34	44	22						29	56	15	14	20		2.4		
23.0	gs			34	44	22						29	50	21	13	20		1.6		
24.2	gs			34	44	22						22	54	24	14	26		1.5		
25.6	gs			33	46	21						30	47	23	15	20		1.3		
27.0	gs			37	41	22						27	50	23	21	25		1.4		
30.0	gs																			
34.4	gs																			
39.4	bc-o			37	33	30						20	70	10	32	17		4.3		
42.7	bc-o			26	45	29						27	55	18	5	7		2.1		
47.6	bc-o			44	31	35						30	55	15		5		2.4		
49.5	bc			35	38	27						6	67	27	37	14		1.7		
51.5	bc			38	36	36						4	69	27	36	14		1.7		
53.4	bc			43	36	21														
55.4	bc			41	37	22						5	70	25	35	16		1.9		
57.4	bc			45	33	22						5	70	25	35	16		1.8		
59.4	bc			41	38	21						5	66	29	26	7		1.6		
61.7	bc			45	36	19						6	67	27	28	8		1.7		
64.0	bc			41	39	20						4	63	33	27	12		1.3		

OUTCROP SECTION 5 OF KETTLES (1980)

ELEVATION: 597 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT	<2mm																
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
	2.0	gv-mo										27	61	12	38	24	15>	3.3		
	5.0	gv-mo		46	32	22						12	74	14	33	23	7>	3.6		
	8.0	gv-mo		50	26	24						15	70	15	35	30		3.1		
	10.5	gv-mo		42	35	23						25	59	16	36	29	6>	2.6		
	10.5	gv-mo		37	39	24						26	58	16	21	19	15>	2.4		
	11.5	gs-o		23	54	23						49	40	11	22	16		2.4		
	11.5	gs-o		23	55	22						45	45	10	17	13		3.1		
	14.4	gs-o		24	52	24						50	39	11	15	13				
	16.4	gs-o		29	48	23						36	53	11	20	13		3.2		
	23.0	gs-o		38	37	25						28	61	11	25	24		3.6		
	26.0	gs-o		35	41	24						30	58	12	27	18		3.2		
	26.2	gs-o		35	40	25						38	53	9	10	26		4.0		
	28.9	bc-o		23	52	25						40	45	15	10	13		1.9		

OUTCROP SECTION 89 OF KETTLES (1980)
ELEVATION: 633 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
	8.2	gv-mo		46	30	24						20	70	10	27	21		4.7		
	10.9	gv-mo		46	30	24						17	72	11	22	22		4.6		
	11.4	gv-z		92	4	4														
	12.5	gv-mo		46	30	24						17	71	12	50	40		4.2		
	14.1	gv-mo		44	35	21						17	70	13	54	31		3.6		
	14.8	gv-mo		46	31	24						16	71	13	51	30		3.6		
	17.3	gv-mo		47	30	23						16	71	13	43	30		3.6		
	18.8	gs-o		40	37	23						30	58	12	27	29		3.2		
	18.8	gs-o		41	40	19						24	58	18	29	28		2.2		
	19.0	gs-o		40	39	21						26	55	19	33	24		2.0		
	19.7	gs-o		41	39	21						26	55	19	26	26		1.9		
	20.3	gs-o		36	45	20						31	51	18	22	24		1.9		
	20.7	bc-o		35	44	21						33	55	12	10	17		2.9		
	21.0	bc-o		30	32	37						32	54	14				2.5		
	21.3	bc-o		32	35	33						29	56	15				2.4		
	24.6	bc-o		33	37	30						19	65	16	4	10		2.6		

BOREHOLE # MARSHALL CONTROL HOLE (KETTLES, 1980)

ELEVATION: 610.0 ft

SAMPLE IDENTIFICATION			PARTICLE SIZE DISTRIBUTION				ENGINEERING DATA					MINERALOGY OF THE <2um FRACTION								
			TOT		<2mm															
DEP TOP	DEP BOT	UNIT	GVL %	SD %	ST %	CL %	Cu	W%	LL	PL	PI	EXP %	ILL %	C-K %	CAL	DOL	VERM IND	DI	HSI	INT CPS
	11.8	gv-mx		39	32	29						32	60	8				5.1		
	12.1	gv-mx										23	67	10				4.6		
	12.5	gv-mx										23	69	8				6.0		
	13.1	gv-mo										18	72	10				4.5		
	13.8	gv-mo										16	73	11	43	31		4.3		
	14.1	gv-mo										16	73	11	13	25		4.8		
	14.4	gv-mo										16	72	12	68	28		4.0		
	15.1	gv-mo		32	37	31						15	75	10	54	14		4.7		
	15.7	gv-mo										14	77	9	43	14		4.5		
	16.4	gv-mo										10	76	14	52	23		3.7		
	17.1	gv-mo										7	74	19	75	23		2.5		
	17.7	gv-mo										6	75	19				2.7		
	18.7	gv-mo										6	70	24	64	20		1.9		
	19.0	gv-mo										6	72	22	60	29		2.1		
	19.4	gv-u										4	68	28	48	21		1.7		
	20.0	gv-u		35	36	29						7	67	26	53	27		1.8		
	20.9	gv-u										8	64	28	41	12		1.5		
	22.0	gv-u										5	67	28	48	22		1.6		
	23.0	gv-u										6	66	28	33	23		1.6		
	23.9	gv-u										5	67	28	56	20		1.6		
	24.9	gv-u										6	65	29	48	21		1.5		
	28.9	gv-u		35	37	28						6	64	30	51	20		1.5		
	29.5	gv-u										5	67	28	38	16		1.6		
	31.5	gv-u		37	38	25						8	63	29	30	13		1.5		
	32.1	gv-u		23	49	28						10	59	31	25	12		1.3		
	33.5	gv-u		46	28	26						11	61	28	21	12		1.4	X	
	34.1	gs-z		61	25	14						10	62	28	28	16		1.5		
	36.1	gs-z		66	17	17						12	62	26	22	13		1.5		
	37.1	gv-u		35	39	26						9	65	26	50	19		1.7		
	38.1	gv-u										8	64	28	60	24		1.5		
	39.1	gv-u										7	65	28	44	22		1.5		
	39.4	gv-u										7	59	34	23	12		1.2		
	39.7	gv-u		36	38	26						7	55	38	20	11		1.0		
	41.7	gv-u										10	54	36	21	12		1.0		
	42.0	gv-u										7	56	37	21	11		1.0		
	42.7	gv-u		49	31	20						8	57	35	17	15		1.1		

Boring or outcrop	71/2 Map	Township	Range	Section	**ft from	**ft from
CLK-02-03	Casey	11N	13W	30	1330'SL	50'EL
CC-5	Westfield East	11N	13W	17	1550'NL	1000'WL
CC-8	Marshall	11N	12W	02	1000'NL	1800'WL
CC-11	Snyder	10N	12W	09	670'NL	3100'EL
CC-15	Clarksville	11N	13W	29	350'NL	2980'EL
CC-16	Westfield East	11N	13W	29	800'NL	1850'WL
CC-17	Westfield East	11N	13W	29	1100'NL	1500'WL
CC-18	Westfield East	11N	14W	25	650'NL	400'EL
CC-19	Westfield East	11N	13W	29	1120'NL	1350'WL
CC-20	Casey	10N	14W	08	900'SL	1770'WL
*WHJ#48	Marshall	12N	12W	34	1650'SL	350'WL
*Clarksville	Clarksville	12N	13W	36	(NW 1/4)	
*Sect. 5	Clark Center	10N	12W	05	100'SL	100'WL
*Sect. 89	Clarksville	11N	13W	14	2320'NL	2050'WL
*Marshall control hole	Marshall	11N	12W	23	2650'NL	2000'EL

*from Kettles (1980)
**footages estimated from topographic maps